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NOTES

ON THE

YEAR'S NAVAL PROGRESS.

JULY, 1895.

NAVY DEPARTMENT,
OFFICE OF NAVAL INTELLIGENCE.

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TABLE OF CONTENTS.

Page.
List of illustrations 5
Introduction 7
I. Notes on ships and torpedo boats 9
II. Notes on ordnance and armor 65
III. Notes on small arms 93
IV. The progress in the naval use of electricity 103
V. On water-tube boilers 131
VI. Tubulous boilers in the French navy 141
VII. Naval manœuvres, 1894 177
VIII. Preliminary notes, Japan-China war 215
IX. Some standard books on professional subjects 235
Index 255

LIST OF ILLUSTRATIONS.

	Page.
Austrian coast-defense vessel *Monarch*	12
French protected cruiser *Descartes*	22
French river gunboats	23
Italian battle ship *Dandolo*	47
Russian battle ship *Sisoi Velikii*	55
Russian armored cruiser *Rurik*	58
Breech mechanism of the 100, 138.6, and 164.7 millimeter converted to R. F. G.	67
Section of same	67
Percussion lock as fitted to same	68
French 194-millimeter guns fitted with *viroles*	69
French 274-millimeter guns fitted with *viroles*	69
French 164.7-millimeter guns fitted with *viroles*	69
Canet 164.7-millimeter R. F. G. and mount	70
Canet 138.6-millimeter R. F. G. and mount	70
Canet 10-centimeter, L/80, R. F. G	70
Canet 57-millimeter, L/80, R. F. G	70
Canet 10-centimeter R. F. G. and central-pivot mount	70
Canet 12-centimeter R. F. G. and turret mount	70
Nordenfelt 75-millimeter R. F. field gun, breech of	73
Nordenfelt 75-millimeter R. F. field gun	74
Nordenfelt 57-millimeter R. F. G., *caponnière* mount for	74
Nordenfelt 65-millimeter R. F. G., cone mount for	74
Nordenfelt 47-millimeter R. F. G., cone mount for	74
Nordenfelt 12-centimeter R. F. G. on central-pivot mount	75
Hotchkiss automatic machine gun and tripod	76
Hotchkiss automatic machine gun and tripod secured for transportation	76
Darmancier breech plug	76
Darmancier breech mechanism	76
Darmancier 75-millimeter R. F. G	76
Elswick 8-inch R. F. G	79
Bofors 12-centimeter R. F. G	80
Marrel Frères Harveyed armor plate	85
Marrel Frères deck plate, front view	85
Marrel Frères deck plate, rear view	85
Marrel Frères, *Pothuau*, face-hardened plate	85
Krupp face-hardened nickel-steel plate, No. 413 II	86
Krupp face-hardened nickel-steel plate, No. 413 II, rear view	86
Krupp face-hardened nickel-steel plate, No. 413 II, backing	87
Krupp face-hardened nickel-steel plate, No. 425 B	87
Krupp face-hardened nickel-steel plate, No. 425 B, rear view	87
Krupp face-hardened nickel-steel plate, No. 425 B, backing	87
Krupp face-hardened nickel-steel plate, No. 432 O	88
Krupp face-hardened nickel-steel plate, No. 432 O, rear view	88
Krupp face-hardened nickel-steel plate, No. 432 O, backing	88

Page.
Krupp face-hardened nickel-steel plate, No. 432 a 88
Krupp face-hardened nickel-steel plate, No. 432 a, rear view 88
Krupp face-hardened nickel-steel plate, No. 432 a, front and side views of backing 88
St. Chamond plate, dimensions: 6.9 by 6 feet by 5.9 inches 90
St. Chamond plate, dimensions: 5.6 by 5 feet by 3.9 inches 90
St. Chamond plate, dimensions: 6 by 5 feet by 5.9 inches 91
St. Chamond plate, dimensions: 7 by 6 feet by 9.45 inches 92
Mannlicher automatic breech mechanism 95
Russian infantry rifle, M/91 98
Range finder 112, 114
Stadimeter 116
Range-indicator system 118
Range indicator 119
Transmitter of orders 119
Electric telescope sight for turret 121
View of ship, ordinary gun sight, naked eye 122
View of ship through telescope sight 122
Position finder 123, 125, 127
Du Temple and Du Temple-Normand boilers 140
Normand boiler, latest type 140
Lagrafel-D'Allest boiler 144
Lagrafel-D'Allest boiler, water legs of 157
Lagrafel-D'Allest boiler, method of projecting holes from tube sheet 157
Niclausse boiler, section and views, evaporating and circulating tubes 169
British manœuvre field, chart of 200
French manœuvre squadron, formation at anchor 207
French manœuvre squadron, formation under weigh 207
French manœuvre field, Channel 208
French manœuve field, Mediterranean 214
Battle off the Yalu, phases of 224
Map of the theater of Japan-China war .... pocket.

INTRODUCTION.

In addition to the usual notes on *matériel* continued from previous annuals there is reprinted, by permission, a valuable paper on water-tube boilers, read at the last meeting of the Institution of Naval Architects, by M. Normand, the distinguished engineer and torpedo-boat builder. The subject is also treated in Chapter VI, which is a reprint from the Journal of the American Society of Naval Engineers, Washington, D. C.

The notes on the war in the East are preliminary to a more technical account, for which all the data are not available at the time of going to press.

A new arrangement of the list of standard professional books is made, in order to conform to that in the catalogues of ships' libraries, with a view of making it supplementary to them; consequently books now issued to ships are not listed.

F. SINGER,
Chief Intelligence Officer.

NAVY DEPARTMENT, *July 1, 1895.*

I.

NOTES ON SHIPS AND TORPEDO BOATS.

By Lieut. L. S. Van Duzer, United States Navy,
Staff Intelligence Officer.

ARGENTINA.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

No definite program of construction seems to have been prepared, but it is rumored that the Government has decided to acquire by construction or purchase two armored vessels of about 5,500 tons, 18 feet draught, and 20 knots speed; two large cruisers; and two steamers for use as transports, one of which will be fitted as a school ship.

SCHOOL SHIP.

A school ship of 2,500 tons displacement is under construction at the yard of Messrs. Laird Brothers, Birkenhead, England. She is to be ship-rigged and fitted with guns of all types and calibers used in the Argentine navy, also with two torpedo tubes. In case of war she will, when necessary, be used as a transport, and her design is such as to render her adapted to this service.

GIUSEPPE GARIBALDI.

(Page 61, General Information Series No. XIII.)

This armored cruiser is building at the yards of Messrs. Ansaldo Brothers, Sampierdarena, near Genova (Genoa), where she was launched May 27, 1895. She was intended for the Italian navy, but has been purchased by Argentina. The principal characteristics are:

Armament.—Two 254-millimeter (10-inch) guns, mounted singly in barbette towers on the main deck forward and aft, with arc of fire of about 270 degrees; ten 152-millimeter (6-inch) guns in broadside on gun deck in the central armored citadel, five each side, with arc of fire of about 150 degrees, 75 degrees forward and abaft the beam; six 120-millimeter (4.7-inch) R. F. G. on main deck, two forward and two after guns firing parallel with keel and having arc of fire of nearly 180 degrees; the other two 4.7-inch guns are in broadside, with arc of fire of about 150 degrees; ten 6-pounder R. F. G., of which four are on the gun deck, two forward, two aft, and two on the upper deck; ten 1-pounder R. F. G., in tops and on the upper deck, bridges, etc. Four torpedo tubes are fitted, one in each corner of the armored citadel on the berth deck; and there are openings in the stem and stern post for tubes if it is thought desirable to fit them.

Protection.—The water-line belt is complete, 8.2 feet wide, 5.9 inches thick throughout the length of the citadel and thence tapering to 2.75 inches at the ends. The citadel rises above the belt amidships to the level of the main deck, and it is the full length of the engine and boiler spaces; it protects the 152-millimeter guns and all ammunition hoists, torpedo tubes, communication tubes, etc.; its armor is 5.9 inches thick throughout on sides and ends. The barbette towers are 5.9 inches thick, and their loading tubes are protected by the armor of the citadel. The protective deck is everywhere 1.18 inches thick, and the part of the main deck which covers in the citadel is 1.96 inches thick. The splinter bulkheads in the citadel are all 0.3 inch thick and the conning towers 5.9 inches. All armor is of nickel steel without face hardening.

Machinery.—The engines are vertical, 3-cylinder, triple-expansion, of about 13,000 I. H. P., designed to give a speed of 20 knots. The boilers are single-ended, cylindrical.

Dimensions.—Length, 393.7 feet; beam, 59.7 feet; displacement, 6,840 tons (metric).

BUENOS AIRES.

This high-speed protected cruiser is building at the works of Sir W. G. Armstrong, Mitchell & Co., Limited, Elswick, England, and was launched May 10, 1895. She was purchased by the Argentine Government while on the ways. The principal characteristics are:

Armament.—Two 8-inch new-type Armstrong guns, one forward, one aft; ten 4.7-inch R. F. G. in broadside (some with ahead or stern fire); sixteen 3-pounders; six 1-pounders; and five torpedo tubes.

Protection.—Complete protective deck, 5 to 1.5 inches thick; gun shields.

Motive power.—Twin-screw engines; contract requirements are 17,000 I. H. P. and 22.75 knots speed, but it is expected that 24 knots will be obtained on trial. The bunker capacity is about 1,000 tons.

Dimensions.—Length over all, 424 feet; length between perpendiculars, 396 feet; beam, 47 feet 2 inches; mean draught, 17 feet 7 inches; displacement, about 4,500 tons.

STEAM TRIALS.

PATRIA.

(*See* page 3, General Information Series No. XIII.)

This vessel was tried during the summer of 1894. The first trials took place in Liverpool Bay during heavy weather, when for 8 hours, under natural draft, the mean speed was 17.6 knots, with an average of 201 revolutions. During this trial 6 runs over a base 8.1 miles long, between two light-houses, gave a speed of 17.915 knots. The forced-draft trial took place on the Clyde. The mean result of 6 runs over the measured mile was 20.575 knots, with 233.5 revolutions. During 3 hours' continuous steaming with forced draft the mean speed was 20.56 knots, with 233.4 revolutions. The vessel was also run over the measured mile, while under natural draft, at 190 revolutions. On the basis of her former natural-draft trial results, this should have given 17.5 knots, but the actual speed made was 17.772. The contract requirement was 19.5 knots with forced draft.

TORPEDO BOATS.

Six first-class torpedo boats are included in the new programme, and have been ordered from Messrs. Yarrow & Co., Poplar, England. They will be of a modified *Havock* type (p. 39, No. XIII).

AUSTRIA.

Budget for 1895.—The total amount of the Naval Budget for 1895 is 12,981,260 gulden ($6,260,212.64), an increase of 503,580 gulden over that for 1894.

Ordinary expenditure, construction items:	
Coast-defense vessel *Monarch* (*A*), third payment	$409,912.50
New engines and boilers for the Danube monitors *Maros* and *Leitha*, third payment	12,538.50
New boilers for the *Saida* (cruiser, 2,500 tons), *Zara* (torpedo vessel, 850 tons), *Zrinyi* (cruiser, 1,370 tons), *Lussin* (torpedo vessel, 1,400 tons), and for torpedo boats	59,799.00
Extraordinary expenditure, construction items:	
Kaiserin und Königin Maria Theresia, sixth payment	9,645.00
Coast-defense vessel *Wien* (*B*), third payment	380,977.50
Coast-defense vessel *Buda-Pest* (*C*), second payment	366,510.00
Six first-class torpedo boats, first payment	86,805.00

Estimates for 1896.—The Austrian naval estimates for 1896 amount to 13,481,260 gulden ($6,501,337.64), an increase of 500,000 gulden ($241,125) over the budget appropriation for 1895. Of this total $4,998,067.94 are in the ordinary estimates and $1,503,269.70 in the extraordinary estimates.

Ordinary estimates, construction items:	
Coast-defense vessel *Monarch* (*A*), fourth payment	$361,687.50
Torpedo vessel of 2,000 tons, first payment	96,450.00
Torpedo vessel of 500 tons, first payment	33,757.50
New boilers for the *Aurora* (cruiser, 1,370 tons), *Zrinyi* (cruiser, 1,370 tons), *Lussin* (torpedo vessel, 1,400 tons), *Sebenico* (torpedo vessel, 900 tons), and for torpedo boats	50,154.00
Extraordinary estimates, construction items:	
Coast-defense vessel *Wien* (*B*), fourth payment	380,977.50
Coast-defense vessel *Buda-Pest* (*C*), third payment	366,510.00
Six first-class torpedo boats, second payment	86,805.00
First-class cruiser, 6,100 tons, first payment	62,692.50

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

FIRST-CLASS CRUISER.

This vessel will have a displacement of 6,100 tons and is to be of the *Kaiserin und Königin Maria Theresia* type, but with greater speed and protection. The total estimated cost, exclusive of armament, is $1,832,550.

TORPEDO VESSEL OF 2,000 TONS.

To replace the *Greif*, no longer considered as possessing the requirements of a torpedo vessel. Total estimated cost, exclusive of armament, $723,375.

TORPEDO VESSEL OF 500 TONS.

This vessel has been ordered from the F. Schichau Company, Elbing, Germany. The estimated cost is $254,145.75. It is the intention to build several more vessels of the same type.

VESSELS LAUNCHED.

MONARCH (A).

(Page 146, No. XII; 5, No. XIII.)

This coast-defense vessel (*see* fig. 1) was launched at the Imperial dockyard, Pola, May 9, 1895. She is the first one of the three coast-defense vessels, mentioned on page 5, No. XIII, to take the water. The keel was laid August 1, 1893, and her sister ships, *Wien* and *Buda-Pest*, were commenced somewhat later in the year at the Stabilimento Tecnico Triestino, a private shipyard at San Rocco, near Trieste. The hull, which is not sheathed, is of Siemens-Martin steel, and is divided into the usual cellular water-tight compartments. The general appearance of the vessel, together with her exterior arrangements, is shown in the plans on fig. 1. The principal details are as follows:

Armament.—The main battery consists of four 24-centimeter (9.45-inch) L/40 Krupp guns, mounted in pairs in the two barbette towers, with arcs of train of 130 degrees on each side of the midship line, and six 15-centimeter (5.9-inch) Krupp guns in the armored inclosure on the main deck, three on each side, the two forward and two after guns having arcs of fire of 160 degrees from directly ahead or astern, while the other two are in broadside, training about 75 degrees forward and abaft the beam. The 15-centimeter guns are separated from each other by splinter-proof bulkheads. The auxiliary battery consists of two 7-centimeter (2.76-inch) Uchatius boat (and field) guns, sixteen 3-pounder R. F. G., and two 8-millimeter (0.315-inch) machine guns. Of these, two 3-pounders and the two machine guns are in the military tops. Ten of the 3-pounders are mounted on the upper deck, which covers in the armored inclosure containing the 5.9-inch guns, and also extends over the remainder of the superstructure. The guns and ammunition hoists are operated by electric power. The ammunition for the heavy guns and auxiliary battery is provided through separate armored tubes.

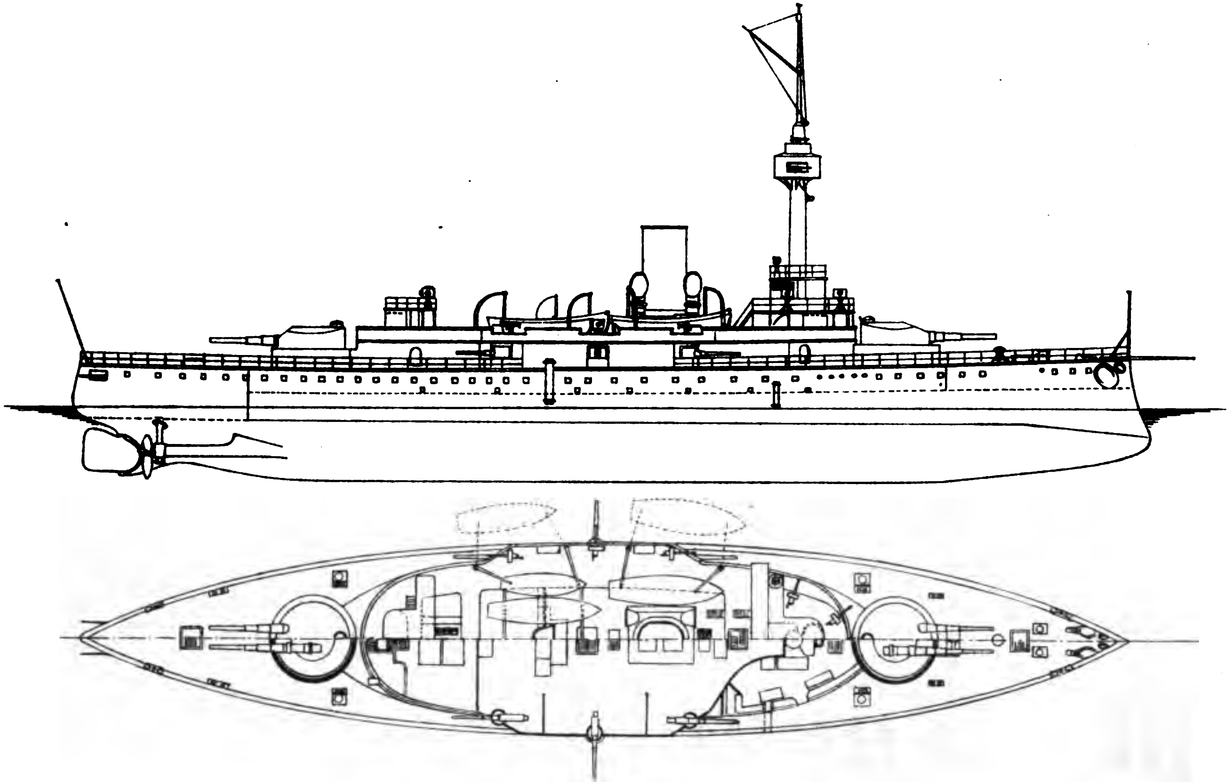

Fig. 1. AUSTRIAN, COAST DEFENCE VESSEL MONARCH

Protection.—The protection to floatation consists primarily of a partial water-line belt 6 feet 11 inches wide, extending 3 feet 11 inches below water, and rising 3 feet above it. This belt extends aft from the stem (where it curves down slightly, but does not reach within two or three feet of the point of the ram), for about five-sixths of the length of the ship, to a point well abaft the after barbette, where it ends in an 8-inch thwartship armored bulkhead. The thickness of the belt is 10.63 inches over the middle body, tapering to 5 inches at the forward and 8 inches at the after end. Above this belt there is a flat, protective deck 1.6 inches thick, and abaft it a protective deck 2.35 inches thick and nearly flat. Above the water-line belt the side armor, 3.15 inches thick, extends from the after end of the belt to a short distance beyond the forward barbette. The ends of the side armor are joined by thwartship bulkheads of the same thickness, thus forming a central armored citadel extending to the level of the main deck. Above this still, on the main deck, there is a bottle-shaped armored inclosure, with sides of 3.15 inches thickness, forming part of the superstructure and containing and protecting the 5.9-inch guns. The narrow end of this inclosure extends forward to the base of the military mast. Forward and abaft the superstructure are the barbette towers for the heavy guns. They are plated with 9.8-inch armor, vertical, circular in horizontal section, and surmounted by turrets, of which the forward one has a thickness of 7.9 inches and the after one 5.1 inches. There are two conning towers, the forward one 7.9 inches thick, the after one 3.9 inches. The whole weight of armor carried is about 1,700 tons.

Motive power.—The engines are twin-screw, triple-expansion, designed to develop 6,000 I. H. P. with natural draft and 8,500 I. H. P. with forced draft. The corresponding expected speeds are 16 and 17.5 knots. The coal capacity is 500 tons and the estimated steaming radius is 3,000 nautical miles at 10 knots. The engines are building at the Stabilimento Tecnico Triestino.

Dimensions.—Length between perpendiculars, 306.1 feet; extreme breadth at the water line, 55.78 feet; mean draught, 20.83 feet; displacement, 5,550 metric tons (5,462 tons of 2,240 lbs.)

STEAM TRIALS.

KAISERIN UND KÖNIGIN MARIA THERESIA.

(Page 357, No. VIII; 45, No. X; 146, No. XII.)

This lightly armored cruiser finished her steam trials during the latter part of 1894. They consisted of a run with natural draft for 6 hours and one with forced draft for 4 hours. On the former, the mean speed was 17.13 knots with 104 revolutions and 5,880 I. H. P. On the latter, with an air pressure of 1.5 to 2 inches, the mean speed was 19.349 knots with 119 revolutions and 9,755 I. H. P. The maximum speed attained during the forced-draft trial was 19.9 knots with 123 revolutions and 10,300 I. H. P.

TORPEDO BOATS.

Six first-class boats are to be built, at an estimated cost of $520,830. One of these has been ordered of Messrs. Yarrow & Co., Poplar, England. The length will be 148 feet and the beam 14.75 feet. Yarrow water-tube boilers will be fitted.

BRAZIL.

The new program of construction is said to include two small coast-defense vessels, three torpedo vessels, and two light-draught armored vessels; with the possible addition of one or more cruisers and torpedo boats.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

TWO COAST-DEFENSE VESSELS.

These have been ordered of the Société des Forges et Chantiers de la Méditerranée, at La Seyne, France; but at last accounts work upon the second one had not been commenced. The principal particulars of the design of the two vessels are:

Armament.—Four 24-centimeter (9.4-inch) guns, mounted in pairs in turrets forward and aft; two 6-inch rifled howitzers; four 12-centimeter (4.7-inch) R. F. G.; two 12-pounder R. F. G.; six smaller rapid-fire guns.

Protection.—Armor belt, protective deck, and thick gun shields.

Motive power.—Twin-screw, triple-expansion engines designed to develop 2,650 I. H. P. with natural draft and 3,400 I. H. P. with forced draft; the corresponding speeds are estimated to be 13 and 14 knots.

Dimensions.—Length, 267.3 feet; beam (extreme), 47.9 feet; depth, 22.6 feet; draught aft, 13.12 feet; displacement, 3,112 tons.

THREE TORPEDO VESSELS.

Building at the yard of the Germania Company, Kiel. They were ordered in the latter part of 1894. The displacement is about 1,000 tons and the estimated speed at least 22 knots.

VESSELS RE-ARMING, REFITTING, ETC.

RIACHUELO.

The very extensive refit of the second-class battleship *Riachuelo*, 5,791 tons, has been completed at the yard of the Société des Forges et Chantiers de la Méditerranée, La Seyne, France. It included the installation of ten new main boilers, one new auxiliary boiler, thorough repairs to engines, and a new auxiliary armament of rapid-fire guns and torpedoes, in addition to the repairs and alterations in the hull. All the rigging and the old fore and mizzen masts have been removed and the mainmast has been cut down and fitted with a derrick for handling the boats. Two military masts replace the old fore and mizzen masts. Each carries two tops for rapid-fire and machine guns, and search lights. The after mast carries the search-light platform. A spiral iron stairway encircles each mast and gives access to the tops. The ammunition hoists are inside the masts. The electric plant and fittings are wholly new. The sheathing of wood and copper was removed, repaired, and replaced. One 11-meter (36-foot) third-class torpedo boat has been placed on board.

The new auxiliary armament consists of six 12-centimeter (4.7 inch) and twenty-four smaller R. F. G. and machine guns; and five Canet torpedo tubes, four in broadside and one in the stern.

VINTE E QUATRO DE MAIO.

(*See Aquidaban*, page 120, No. IV; 82, No. V; 379 and 410, No. XIII.)

This small battleship is to be thoroughly refitted and supplied with a new battery. She was formerly called the *Aquidaban*, but her name was changed upon her arrival in Rio de Janeiro Harbor (May 24, 1894), after having been torpedoed and recaptured from the rebels.

BULGARIA.

An appropriation of about $4,866,000 was sanctioned by the Government, a year or more ago, for the establishment of a navy; but beyond repairs to the *Krum*, which has been fitted as the royal yacht, nothing is known to have been done.

CHILE.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

It is reported that the Chilean Government proposes to increase the navy by the acquisition of three large vessels. One of these, a very fast cruiser of about 6,000 tons, is said to have been ordered from Sir W. G. Armstrong, Mitchell & Co., Limited, probably an improved *Blanco Encalada* (p. 147, No. XII; 9, No. XIII,) with higher speed and greater protection, particularly to the battery.

VESSELS SOLD.

ESMERALDA.

This protected cruiser was sold to Japan through the agency of certain Ecuadorian Government officials. She stopped at Honolulu on her way to Japan, and was then flying the Ecuadorian flag.

CHINA.

The record of the Chinese navy for the past year has been a disastrous one. The only additions are four new first-class torpedo boats.

VESSELS LOST DURING THE WAR.

The losses include nearly the whole effective fighting material of the navy, and are as follows:

Name.	Type.	Displacement.	Where and how lost.
Chen yuen	Battleship	7,430	Captured at Weihaiwei.
Ting yuen	do	7,430	Torpedoed and sunk at Weihaiwei.
Ping yuen	Coast-defense vessel	2,600	Captured at Weihaiwei.
Lai yuen	do	2,900	Torpedoed and sunk at Weihaiwei.
King yuen	do	2,900	Sunk off the Yalu.
Tsi yuen (Chi yuen)	do	2,355	Captured at Weihaiwei.
Chih yuen	Protected cruiser	2,300	Sunk off the Yalu.
Ching yuen	do	2,300	Sunk at Weihaiwei.
Chao yung	Partially protected cruiser.	1,350	Destroyed off the Yalu.
Kuang kia	do	1,296	Run ashore near Port Arthur, Sept. 17; destroyed, Sept. 23.
Yung wei	do	1,350	Destroyed off the Yalu.
Kuang yi	do	1,030	Run ashore near Asan and destroyed, July 25.
Kuang ping	do	1,030	Captured at Weihaiwei.
Wei yuen	Cruiser	1,300	Torpedoed, Feb. 5.
Tsao kiang	Dispatch vessel	600	Captured at Asan, July 25.
Mei yuen	Gun vessel	558	Captured at Niuchwang.
Chen pien	do	440	Captured at Weihaiwei.
Chen pei	do	440	Do.
Chen chung	do	440	Do.
Chen nan	do	440	Do.
Chen tung	do	440	Do.
Chen si	do	440	Do.

TORPEDO BOATS.

Since the conclusion of the China-Japan war four first-class torpedo boats have been received from the F. Schichau Company, of Elbing, Germany. These boats were completed too late for delivery before the declaration of war. On their recent steam trials the speeds attained were from 24 to 24.75 knots.

The number of Chinese torpedo boats lost during the war has not yet been definitely ascertained. Two attempted to escape from Port Arthur; one was sunk by the Japanese boats and one was beached and destroyed. Six were captured by the Japanese at Weihaiwei and five or six were destroyed.

DENMARK.

The naval budget amounts in all to 7,635,415 kroner ($2,046,291.22). In the ordinary charges the sum of $321,600 is appropriated—for continuing work on the coast-defense vessel *Skjold*, $195,640; for building a first-class torpedo boat, $99,160; and for beginning work on a new armored vessel, $26,800. In the extraordinary charges the sum of $20,100 is allotted to the building of a mining vessel and a submarine mine defense of Copenhagen, $20,368 for the repair of ships, and $98,088 for armaments.

VESSELS LAUNCHED.

HEIMDAL.

(Page 55, No. XI.)

The protected cruiser *Heimdal* was launched at Copenhagen August 31, 1894. The hull is of steel, with double bottom and other water-tight subdivision. The estimated cost is $536,000.

Armament.—Two 12-centimeter (4.7-inch) R. F. G., four 6-pounder R. F. G.; six machine guns; four torpedo tubes.

Protection.—Protective deck, 1.5 inches thick; gun shields.

Motive power.—Twin-screw engines, designed to develop 3,000 I. H. P. with forced draft; corresponding estimated speed, 17.5 knots. Coal capacity, 125 tons.

Dimensions.—Length, 257.5 feet; beam, 27.5 feet; mean draught, 11.3 feet; displacement, 1,280 tons.

ECUADOR.

The small Ecuadorian gunboat *Sucré* blew up, from an unknown cause, during the latter part of May, 1895. The commander and 14 men were killed and 17 others injured.

FRANCE.

Budget, 1895.—The total amount appropriated for the fiscal year beginning January 1, 1895, was 270,366,217 francs ($52,180,680), an increase of $676,405 over the appropriations for the previous year. The amount set apart to be expended in 1895 on vessels building and authorized was $16,618,174.

Seventeen new vessels will be begun during the year. When they are in hand, France will have 76 ships and torpedo boats on the stocks, in dry docks (building), or on trial, distributed as shown in the following table:

Class of ship.	Government dockyards.	Private yards.	Total.
Battleships	7	2	9
Coast-defense vessels	1	2	3
First-class cruisers	3	5	8
Second-class cruisers	6	4	10
Third-class cruisers	2	3	5
Torpedo-depot ships	1	1	2
Torpedo vessels		2	2
Dispatch vessels	2		2
Gun vessels		1	1
First-class torpedo boats		7	7
Smaller torpedo boats		26	26
Submarine boat	1		1
Total	23	53	76

Estimates, 1896.—The total amount of the estimates for 1896 is 272,614,898 francs ($52,614,675.31). The program of new construction to be laid down in 1896, according to the ten-year scheme (*see* p. 27, No. XI), is to be modified like that of previous years. Battleship A^6 and torpedo vessel M^2, belonging to the original program of 1896, have been delayed a year. Battleship A^3 (the *Henri IV*, belonging to the 1894 schedule) will at last be laid down. The number of first-class torpedo boats (sea-going type) has been reduced from three to one, and the number of first-class boats of a smaller type are reduced from six to two.

The new program as presented to the Chamber, May 14, 1895, is as follows:

Vessels.	Where to be built.	Estimated cost.
EUROPEAN SQUADRON.		
Battleship A^3 (Henri IV)	Private yard	$3,531,900
First-class cruiser D^3	do	3,184,500
Large torpedo vessel M^3	do	482,500
First-class torpedo boat N^{12}	do	231,600
COAST DEFENSE.		
Torpedo vessel M^1	Private yard	289,500
First-class torpedo boats P^{25}, P^{26}	do	138,960
FOREIGN FLEET.		
First-class cruiser C^2	Toulon Navy-Yard	3,126,600
Second-class cruiser E^5	Cherbourg Navy-Yard	1,476,450
Third-class cruiser K^3	Rochefort Navy-Yard	772,000
Station dispatch vessel S^2	Toulon Navy-Yard	445,830
Gun vessel T^2	Private yard	220,020
Total		13,899,860

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

Of the vessels mentioned on page 47, No. XIII, the battleship *Henri IV* and protected cruiser E^5 will be laid down in 1896; protected cruisers E^6 and G^3 and dispatch vessel U^1 will not be laid down until after 1896.

GAULOIS (A^7).

The keel of this first-class battleship of 11,260 tons, a sister ship in all essential respects to the *Charlemagne* and *Saint Louis*, will be laid down on the *Charlemagne's* slip at Brest when that ship is launched in the autumn of 1895. The engines of the *Gaulois*, like those of the *Charlemagne*, will be built at Creusot. It is expected that she will be completed in 1900.

JEANNE D'ARC (O).

(Page 153, No. XII; 47, No. XIII.)

Orders were issued in May, 1895, for this vessel to be laid down at Toulon. Her design is believed to be similar in all respects to that of the *D'Entrecasteaux*, fully described on page 46, No. XIII.

CROISEURS CORSAIRES.

These first-class protected cruisers take their temporary name as well as their general character from our *Columbia* and *Minneapolis*, which were jocularly called "*Pirate*" and "*Corsair*" during the periods in which they were officially styled cruisers "*No. 12*" and "*No. 13*." One will be built by the Forges et Chantiers de la Méditerranée at La Seyne and the other by the Ateliers et Chantiers de la Loire at Nantes. They will not be exactly alike, but will resemble each other in all principal features.

Armament.—Two 164.7-millimeter (6.48-inch) guns, one forward, one aft; six 138.6-millimeter (5.46-inch) R. F. G., four on the main deck in redoubts and two on the upper deck, the latter having arcs of fire of 180 degrees, from right ahead to right astern; ten 3-pounder R. F. G. Torpedo tubes will not be fitted.

Protection.—Protective deck of polygonal section, made up of plates of 24 and 15 millimeters, giving a total thickness on the slopes of 39 millimeters (1.28 inches). There will be no splinter deck. The thickness of the redoubt armor over the 5.46-inch guns is 1.77 inches, and the guns are fitted with shields like those on the *Pothuau.* The two upper 5.46-inch guns will have 1.77-inch shields. The thickness of the conning tower will be about 8 inches. Torpedo nets will not be carried.

Motive power.—Vertical, triple-screw engines of about 24,000 I. H. P. The contract speed requirements are 23 knots with forced draft, but without closing the fire room and with a combustion not to exceed 30.6 pounds of coal per square foot of grate per hour; with natural draft, 20 knots during 24 hours with a combustion of 18.4 pounds per square foot. The coal capacity is to be about 1,500 tons, or sufficient to give a steaming radius of 7,500 nautical miles at 12 knots.

Dimensions.—Length not to exceed 436 feet (probably about 425 feet); beam about 58 feet; draught not to exceed 24.6 feet; displacement, 8,000 to 8,500 tons.

PROTET (E^4).

This second-class cruiser is to be given out to contract during the summer of 1895 and completed in 1898. The hull is of steel, sheathed with wood, and coppered, as she is intended chiefly for colonial service. The approximate characteristics are:

Armament.—Four 164.7-millimeter (6.48-inch) guns; ten 100-millimeter (3.9-inch) R. F. G.; ten 3-pounder R. F. G.; and four 1-pounder R. F. G. Two torpedo tubes will be fitted.

Motive power.—Vertical engines; Belleville boilers; designed I. H. P., 9,000; estimated speed with this power, 19 knots. Coal supply, 571 tons; steaming radius, 6,000 nautical miles at 10 knots, and 1,000 miles at full speed.

Dimensions.—Length, 331.4 feet; beam, 44.62 feet; displacement, about 4,000 tons.

The estimated cost is $1,588,993, and the complement 14 officers and 370 men.

THIRD-CLASS CRUISERS K[1] AND K[2].

These two third-class cruisers are to be built for colonial service. The hull is of steel, sheathed with wood, and coppered. They will be built by contract and are to be completed in 1896. The estimated cost is $831,328.78 each. The principal characteristics are said to be:

Armament.—Four 138.6-millimeter (5.46-inch) guns; five 65-millimeter (2.56-inch) R. F. G.; and eight 1-pounder R. F. G.

Motive power.—D'Allest boilers; twin-screw engines of 3,150 I. H. P.; estimated speed, 16 knots. Coal capacity, 270 tons; steaming radius, 5,000 nautical miles at 10 knots, and 1,350 miles at full speed.

Dimensions.—Length, 246 feet; beam, 35.5 feet; displacement, 1,756 tons.

The complement will be 13 officers and 186 men.

SMALL STEEL CRUISER.

It was reported last summer that a small steel cruiser, of exceptional speed and coal endurance, was to be laid down at Brest. The speed, with forced draft, was to be 23 knots. Armament to consist of ten 100-millimeter (3.9-inch) and twelve 3-pounder R. F. G. Pole masts without military tops were to be fitted.

No further information concerning this vessel has transpired, and it is supposed that the project, if project there was, has been abandoned.

KERSAINT (S[2]).

This station dispatch vessel is to be built at Toulon dockyard and completed in 1897. The hull is of steel, sheathed with wood and coppered. The estimated cost is $464,587.28. Through an error in copying, the name of *Raymond* was assigned to this vessel in the last annual. (*See* p. 45, No. XIII.) The principal characteristics are:

Armament.—One 138.6-millimeter (5.46-inch) gun; five 100-millimeter (3.94-inch) R. F. G.; seven 1-pounder R. F. G.

Motive power.—Single-screw engines of 2,200 I. H. P.; estimated speed, 15 knots. The coal capacity is 200 tons, and the steaming radius at 10 knots, 4,000 nautical miles.

Dimensions.—Length, 223 feet; beam, 36 feet; displacement, about 1,243 tons.

VESSELS LAUNCHED.

CARNOT.

(Page 27, No. IX; 31, No. X.)

This first-class battleship was launched at Toulon dockyard July 12, 1894. She was laid down in 1891 as the *Lazare Carnot*, but after the assassination of the late President Carnot it was decided to call her the *Carnot*, in remembrance of him as well as of his grandfather.

The hull is of steel, without sheathing, and the vessel is, in all essential particulars, a sister ship to the *Charles Martel.* Two military masts are fitted and there are two smoke pipes. The following are the principal characteristics:

Armament.—Two 305-millimeter (12.01-inch) L/45 guns, mounted singly in closed turrets on the midship line forward and aft; two 274.4-millimeter (10.81-inch) L/45 guns in waist turrets on each side; eight 138.6-millimeter (5.46-inch) guns mounted singly in closed turrets (*see Protection* for positions of small turrets); six 65-millimeter (2.56-inch) R. F. G. on the upper and bridge decks; eight 3-pounders in the lower tops, and eight 1-pounders in the upper tops. The axis of the forward 305-millimeter gun is 26.17 feet above the water line and that of the after one 19.6 feet when the vessel is at her designed load draught; the height of the 274.4-millimeter guns is about the same as that of the after 305-millimeter.

Six torpedo tubes are fitted, of which four are above water.

Protection.—The protection consists of a thick water-line belt, cofferdam belt, twelve closed turrets, conning tower, protective deck, and splinter deck. The water-line belt is continuous from stem to stern; it is 17.7 inches thick at the upper edge over the middle body, tapering to 9.8 inches at the lower edge, and it is reduced in thickness at the upper edge to 13.78 inches forward and 12.2 inches aft; this water-line belt is about 6.5 feet wide and rises about 1.5 feet above water. The cofferdam belt also extends from stem to stern, rising directly above the thick belt; it is 4 feet wide and of a uniform thickness of 3.94 inches throughout. The small turrets are 3.94 inches thick and arranged as follows: One on each side of the forward 305-millimeter turret, but a little abaft and below it; one on each side of the after 305-millimeter turret, but a little forward and below it; one on each side (forward and abaft) the 274.4-millimeter turrets, but a little inboard and below them. The protective deck, above the water-line belt, is 2.76 inches thick. The splinter deck is of ordinary heavy plating.

Motive power.—Triple-expansion, vertical, twin-screw engines of about 10,000 I. H. P. with natural draft, and 13,500 with forced draft; the corresponding estimated speeds are 17 and 18 knots. Steam is supplied by 24 d'Allest boilers. The coal supply is 670 tons; total capacity, 790 tons. The steaming radius, with all coal on board, is 4,000 nautical miles at 10 knots, or 800 miles at maximum speed.

Dimensions.—Length on water line, 380.6 feet; beam, 70.5 feet; mean draught, 26 feet; displacement at this draught, 11,988 metric tons (11,800 tons of 2,240 pounds).

BRUIX.

(Page 341, No. VIII; 27, No. IX; *see* plate of *Chasseloup-Laubat* facing page 47, No. XIII.)

This lightly armored cruiser was launched at Rochefort, August 3, 1894. She is a sister ship to the *Chanzy*, *Latouche-Tréville*, and *Amiral*

Charner. The hull is of steel, unsheathed. Two military masts are fitted, each carrying three tops. The estimated cost is $1,894,102.

Armament.—Two 194-millimeter (7.64-inch) guns in closed turrets (one forward, one aft) on the fore and aft midship line; six 138.6-millimeter (5.46-inch) guns in turrets supported by sponsons, three each side (owing to the tumble home of the upper works these sponsons do not project beyond the side of the ship at the water line); four 65-millimeter (2.56-inch) R. F. G.; six 3-pounder R. F. G., and six 1-pounder R. F. G. Five torpedo tubes are fitted, two forward, one on each beam, and one in the stern. The turrets are balanced, of Canet model, and all operations of loading and training are performed by electric power, but auxiliary hand gear is also fitted.

Protection.—The protection to the hull consists of a broad belt of armor, 3.62 inches thick, extending completely around the ship from well below the water line to a considerable distance above it; a curved protective deck, 1.97 inches thick on the slope and 1.57 inches on the flat; lastly, a cofferdam for obturating material rising 3 feet 11 inches above the water line. A splinter deck of heavy plating is fitted above the machinery space below the protective deck. The armor of all the turrets is 3.62 inches, and the armored shelter, or conning tower, is of the same thickness.

Motive power.—Two vertical engines of 8,700 maximum I. H. P. with forced draft. The estimated speeds are 17 knots with natural draft and 19 knots with forced draft. Steam is furnished by 16 Belleville boilers. The coal supply is 406 tons.

Dimensions.—Length over all, 374 feet; on the water line, 347.75 feet; beam, 45.91 feet; mean draught, 19.17 feet; draught aft, 19.67 feet; displacement, 4,745 metric tons (4,670 tons of 2,240 pounds).

DESCARTES.

(Page 28, No. XI; 154, No. XII.)

This second-class protected cruiser (*see* fig. 2) was launched at the works of the Société des Ateliers et Chantiers de la Loire, Nantes, September 27, 1894. The contract for the construction was signed August 29, 1892; contract time, thirty-three months. The keel was laid in January, 1893. The arrangement of the battery and other details are shown in the accompanying plans. The principal characteristics are:

Armament.—Four 164.7-millimeter (6.48-inch) guns in waist sponsons, two on each side; ten 100-millimeter (3.9-inch) R. F. G., of which two are on the forecastle and two on the poop; ten 3-pounder R. F. G.; four 1-pounder R. F. G. Two torpedo tubes are fitted.

Protection.—Curved protective decks (*see* fig. 2, midship section), 1.92 inches thick on the slope and 1.38 inches thick on the flat over the middle body, and 0.97 inch thick on the flat and slope alike at the ends, where the crown of the deck is much less. The conning tower has a maximum thickness of 3.9 inches; the shields of the 10 and 16 centimeter guns, 2.8 inches; and the communication and loading tubes 3.3 inches.

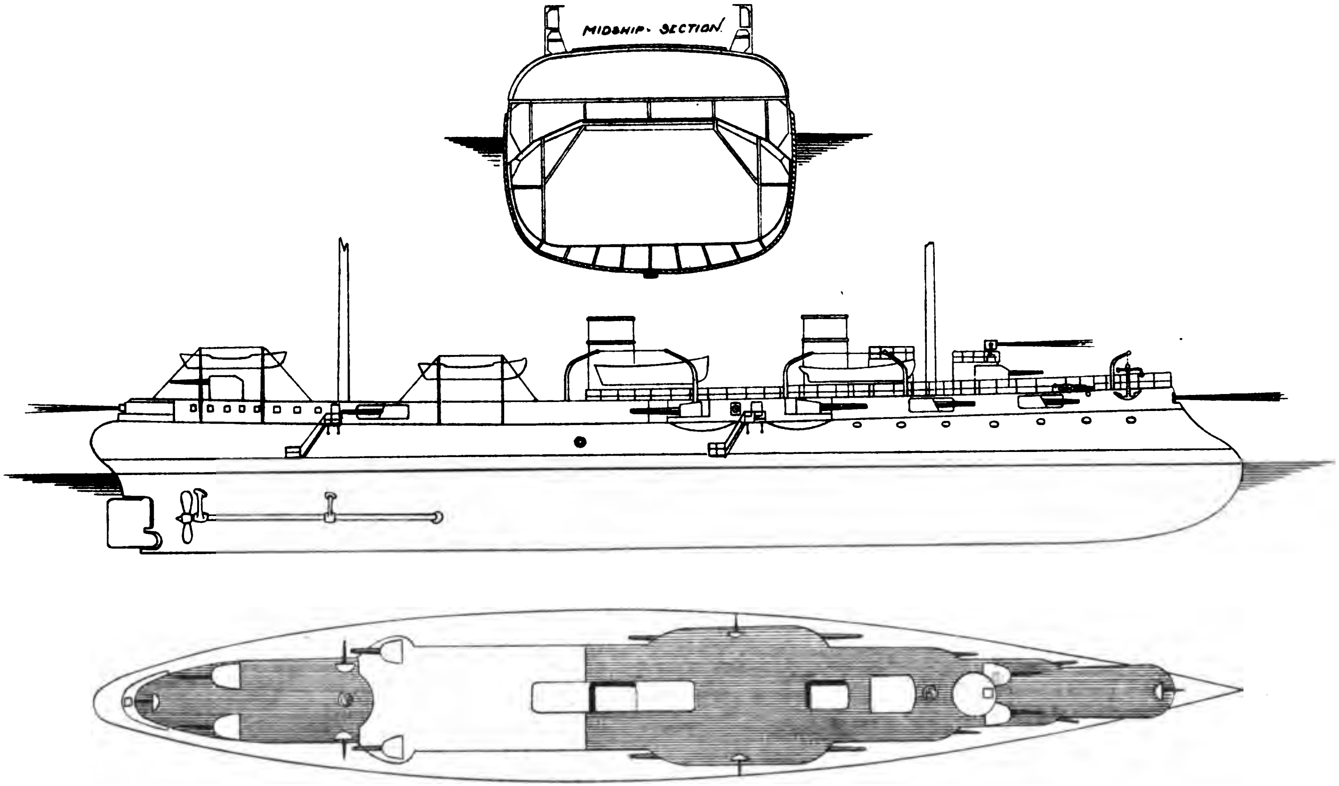

Fig. 2. FRENCH PROTECTED CRUISER DESCARTES.

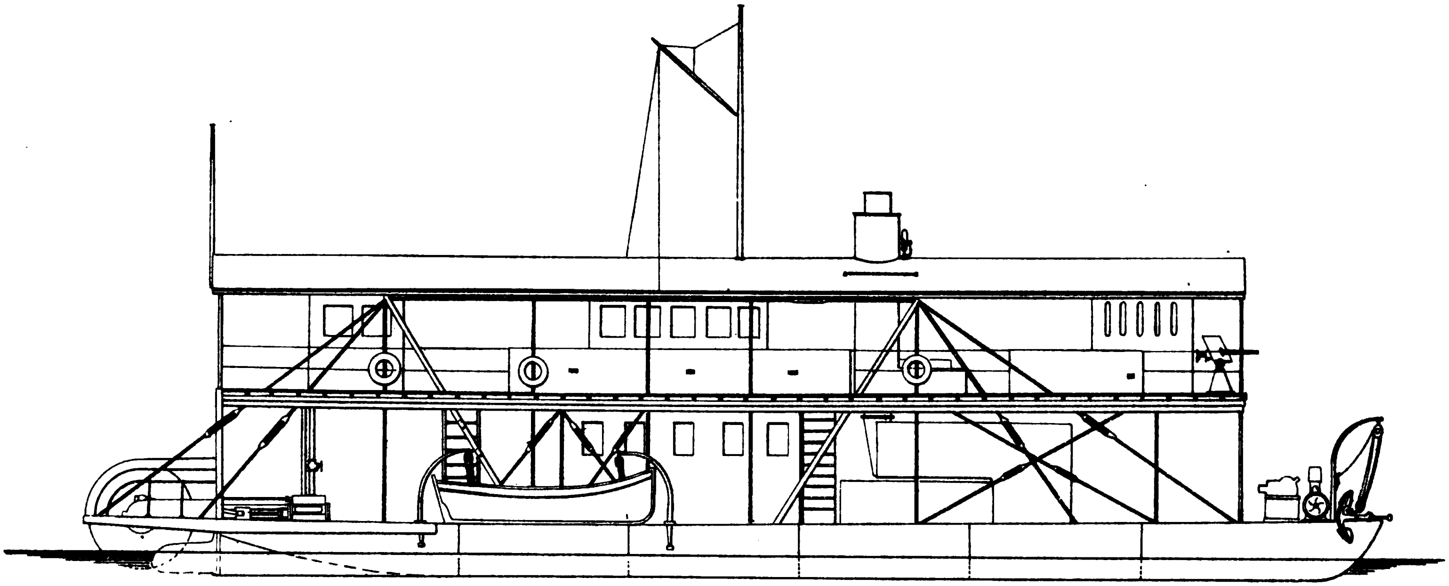

Fig. 3. FRENCH RIVER GUNBOAT.

Motive power.—Two vertical triple-expansion engines, designed to develop 8,500 I. H. P. with forced draft; 16 Belleville boilers, carrying steam at 240 pounds; estimated speed with forced draft, 19 knots. Coal supply at load draught, about 600 tons; total coal capacity, about 800 tons. Steaming radius with full coal supply, 8,000 nautical miles at 10 knots.

Dimensions.—Length between perpendiculars, 315.9 feet; beam, 42.32 feet; mean draught, 19.72 feet; displacement, 3,940 tons (4,000 metric tons).

SURPRISE.

(Page 30, No. XI.)

This gunboat is building at the yard of Messrs. A. Normand & Co., Havre, where she was launched April 24, 1895. The hull is composite, with steel top sides. The wood planking, in two thicknesses, is carried up from the keel to a point about halfway from the water line to the main deck; from this point up the top sides have steel plating without wood sheathing. The bottom is coppered. Three masts will be fitted, to give moderate sail power. The estimated cost is $240,864.

Armament.—Two 100-millimeter (3.9-inch) R. F. G.; four 65-millimeter (2.56 inch) R. F. G.; four 3-pounder R. F. G.

Motive power.—Single-screw, vertical triple-expansion engine, designed to develop 650 I. H. P. with natural draft and 850 with forced draft. Maximum estimated speed, 13 knots. The coal supply is 73 tons.

Dimensions.—Length between perpendiculars, 183.75 feet; beam, 24.6 feet; depth amidships, 13.9 feet; draught forward, 8 feet; draught aft, 12.25 feet; displacement, 613 tons (623 metric tons).

BRAVE, INVINCIBLE, INFERNALE, VIGILANTE, ESPIÈGLE, ÉCLATANTE, IMPETUEUSE, INSOLANT, PRÉCIEUSE, ZÉLÉE, RUSÉE, AND POURSUIVANTE.

These are river gunboats, for service in Madagascar, and of the same type as the *Opale* (p. 30, No. XI), which was employed in the Dahomey campaign. They are all of the same general design (*see* fig. 3), but the first four, built by the Société des Ateliers et Chantiers de la Loire, have a slightly greater draught of water and displacement with increased engine power and speed. The second four, built by the Société des Forges et Chantiers de la Méditerranée at the Graville yard (Havre), and the last four by the same company, at La Seyne, have the same dimensions. They are all built in six water-tight sections for convenience of transport.

Armament.—Two 1-pounder R. F. G. on the upper deck.

Protection.—Conning tower and gun shields.

Motive power.—Two simple engines of 50 I. H. P. (for the last eight), driving a single stern wheel. Estimated speed, 6.5 knots.

Dimensions.—Length, 82 feet; beam, 18 feet; draught, 15.7 inches. For the first four the draught is 20.4 inches.

The *Précieuse*, *Espiègle*, and several others have had their steam trials, which were successful in all respects. They have all been launched.

STEAM TRIALS.

BRENNUS.

(Page 31, No. XI.)

The steam trials of the *Brennus* took place in September, 1894, and a speed of 15.7 knots was made. During the trials it was discovered that the heel was unusually great with the battery trained abeam, and there was other evidence to cause grave doubts of her adequate stability. Subsequent experiments confirmed these doubts, and it was decided that a weight of at least 500 tons must be removed. To accomplish this, orders were given to take out one military mast and to lower the superstructure. This work is now in progess.

Similar alterations are being carried out on the battleship *Magenta*, and have been completed in the *Hoche.*

The *Brennus* has been severely criticised by leading naval authorities, chiefly on account of her small coal supply and the excessive weight of the ammunition tubes and hoists for the 16-centimeter guns. It is asserted, however, that in spite of her defects she is one of the most formidable fighting ships in the world.

JEMMAPES, VALMY, AND BOUVINES.

(Page 32, No. X; 32, No. XI.)

The results of the final trials of the *Jemmapes*, which took place in the summer and autumn of 1894, are as follows:

	Reduced speed, natural draft.	Normal power, natural draft.	Maximum power, forced draft.
I. H. P.	2,219	7,760	9,201.3
Boiler pressure	179	201.5	203.6
Number of boilers used	8	16	16
Heating surface ... square feet	10,862	21,624	21,624
Grate area ... do	323	646	646
Coal per square foot of grate ... pounds	11	23.7	32.5
Coal per I. H. P. per hour ... do	1.354	1.804	2,077
Mean speed ... knots	11	....	16.7

The contract speed and I. H. P. were 16.5 and 8,500 respectively.

The *Valmy* has also completed her trials satisfactorily, attaining a speed of 16.7 knots with 112 revolutions.

The *Bouvines* has had a preliminary trial, but her official trials have not yet been completed.

DUPUY DE LÔME.

(Page 312, No. VII; 35, No. XI; 50, No. XIII.)

After the changes referred to on page 50, No. XIII, had been completed, this ship, in February, 1895, began her preliminary trials, attaining a speed of 18 knots, with 120 (average) revolutions. Later, on her final trials, during fine weather and in a smooth sea, the mean speed developed over the measured mile was 19.8 knots, with about 13,000 I. H. P.; the highest speed attained was 20.4 knots. The mean revolutions of the central screw were 135, and of the side screws 138 and 140. During the 24-hour natural-draft trial the average I. H. P. was 6,250, speed 17 knots, and the consumption of coal per I. H. P. per hour 1.8 pounds. This trial was designed to test her coal consumption, and no attempt was made to develop her full capabilities under natural draft.

LATOUCHE-TRÉVILLE.

(Page 27, No. IX; 156, No. XII; 240, 241, No. XIII.)

This vessel was fitted with twelve Belleville boilers, with fires urged by a new system of induced draft. The steam trials were begun in the summer of 1894. After the preliminary trials it was seen that it was impossible to attain the I. H. P. expected with the induced-draft system employed, and several months were spent in changing to the old system.

In December, 1895, the preliminary trials were again undertaken, only 6,300 I. H. P. being obtained, while 8,000 I. H. P. were required. The machinery worked smoothly enough, but the ventilation was defective and the temperature in the fire rooms during the trial intolerable. During another trial which followed the contract I. H. P. was reached with a resulting speed of 17.5 knots.

Further modifications were made with a view of improving the ventilation, and on her last official forced-draft trial she made 18.16 knots with 8,450 I. H. P. During a previous trial she made 17.5 knots, with 7,400 I. H. P. On March 4, 1895, she made a 24-hour run at about two-thirds power; the mean speed was 16.84 knots, revolutions 110, I. H. P. 5,250. These trials were regarded as satisfactory and she was accepted.

FRIANT AND CHASSELOUP-LAUBAT.

(Page 32, No. X; 156, No. XII; 47 (plate), No. XIII.)

In September, 1894, a natural-draft trial of the *Friant* of 10 hours' duration gave approximately 17.5 knots with 6,000 I. H. P. During the course of her trials a speed of 19.7 knots was obtained. In December, with an I. H. P. of 3,500, the speed was 15 knots, the consumption of coal per horsepower per hour being 1.46 pounds. On a further trial for 6 hours the engines developing 1,650 I. H. P., the mean speed was 11.8 knots. On the 15th of March, 1895, a forced-draft trial was concluded, which was regarded as satisfactory. There was a heavy sea on, but the mean speed developed was 18.8 knots; maximum, 19.3; the I. H. P. 9,503, which is 503 above the contract; revolutions, 126; coal consumption per I. H. P. per hour, 2.01 pounds. A few days later in a 24-hour run, at about three-fifths power (twelve boilers out of twenty), the results were: Speed, 17.1 knots; I. H. P., 6,000; coal per I. H. P. per hour, 2.27 pounds.

The *Chasseloup-Laubat* has been undergoing trial since last November, when, during one of her first experiences, a speed of 17.5 knots was obtained in a rough sea. In December, with eighteen boilers, she made 18.25 knots, the I. H. P. exceeding the expected 9,000. In March, 1894, a speed of 18.77 knots was made with 125.7 revolutions and a coal consumption of 809 grams (1.78 pounds) per horsepower per hour.

Several changes are being made in the vessels of this class. Owing to addition of weights in the upper works while building the displacement was unduly increased and the stability too much reduced. To remedy this state of affairs certain fittings have been removed. The two military masts, carrying fighting tops with rapid-fire guns, have been cut down to the level of the bridge and two light signal masts replace them. The broadside and stern torpedo tubes, with all their gear, torpedoes, one air-compresser, etc., have been removed, and other changes tending to lighten the vessel have been or are being carried out. When the alterations are finished it is hoped that the speed of 19 knots, for which the vessels were designed, will be readily attained.

LINOIS.

(Page 28, No. XI; 49, No. XIII.)

The *Linois* had satisfactory preliminary trials in April, 1895. The speed developed was 17.2 knots with 137.5 revolutions.

FLEURUS.

(Page 28, No. IX; 156, No. XII.)

Since the beginning of her trials, in the summer of 1894, continual trouble has been experienced with the boilers of this vessel on account of various defects. On her last trial, December 4, 1894, leaks and other signs of weakness were developed to such an extent in her boilers that new ones were decided to be necessary. This work has been taken in hand.

The *Fleurus* has been severely criticised as being out of date before completion, as lacking in speed, and as having a crowded emplacement of battery.

D'IBERVILLE AND CASSINI.

(Page 29, No. XI; 50, No. XIII.)

The following table gives results of the final trials of the torpedo vessel *D'Iberville*, 925 tons:

Date.	Duration.	I. H. P.	Revolutions.	Mean speed.	Coal consumption per I. H. P.
1894.					
June 16	6 hours	1,800	207.6	15.82	1.33
June 29 and 30	24-hour run { 18 hours	3,313	258	19.3	1.85
	6 hours	4,400	280	20.7	
July 27	4 hours 16 minutes	5,060	292.3	21.61	2.16

The trial was highly satisfactory in every respect.

The preliminary trials of the *Cassini* were unsatisfactory, owing to troubles with the boilers. A speed of 20 knots, with 150 revolutions, was reached before the trials were given up. The *D'Iberville* had a similar experience in the March preceding the date of the very successful trials whose results are recorded above.

VESSELS RE-ARMING, REFITTING, ETC.

REDOUBTABLE.

This old battleship has undergone extensive repairs; new boilers, a new battery, and other changes. The mean results of the steam trial upon the completion of her refit were: I. H. P., 4,662; speed, over 13 knots. The maximum speed attained is said to have been 15.4 knots, 0.6 of a knot more than on her trial when new.

CECILLE.

(Page 80, 202, No. V; 313, No. VII; 342, No. VIII; 29, No. IX; 36, No. X.)

This large protected cruiser has had an extensive refit. This has included new boilers, an entire new battery, and other important changes. The old masts have been removed and replaced by military masts. On her steam trial, following the completion of her refit, a speed of 19.5 knots was obtained with 97 revolutions and an I. H. P. of a little over 10,000.

DUQUESNE AND TOURVILLE.

These old-type unprotected cruisers of 5,743 tons have been refitted, receiving new boilers, thorough repairs to the engines, and a new armament. The latter consists of seven new-type 164.7-millimeter (6.48-inch) guns, fourteen 138.6-millimeter (5.46-inch) R. F. G., and eight 37-millimeter revolving cannon. On their steam trials after refit the *Duquesne* attained a speed of 16.2 knots and the *Tourville* about 16.

TORPEDO BOATS.

The budget for 1895 provides for the following: First-class boats *Mangini* and *Tenare;* estimated cost, $127,283 each. First-class boats P^{20}, P^{21}, P^{22}, P^{23}, P^{24}; estimated cost, $80,097.80 each. Second-class boats R^4, R^5, R^6, R^7, R^8; estimated cost, $26,749.80 each. First-class boats Q^1, Q^2, Q^3, and Q^4, referred to on page 52, No. XIII, are mentioned in the budget for 1895 for memory only, and will not be laid down until after 1896. All the other boats mentioned in the same paragraph will be laid down in 1895 or 1896.

The following boats are included in the estimates for 1896: One very arge first-class boat, N^{12} to cost $231,600; two smaller first-class boats, P^{25}, P^{26}, each to cost $69,480.

The following torpedo boats, referred to on page 53, No. XIII, have had successful trials, and have been accepted by the Government: *No. 182,* speed, 24 knots; *No. 183,* speed, 24.5 knots; *No. 185,* speed, 24.5 knots; *No. 191,* speed, 25.5 knots; *No. 192,* speed, 23.54 knots.

The *Lansquenet* (p. 37, No. XI; 53, No. XIII), on her preliminary trial, after extensive alterations, made 24.5 knots; on her natural-draft trial, 18.79 knots with 360 revolutions. She then attempted her official forced-draft trials, and made one run at 25.45 knots against the tide, when she broke a cylinder and piston. After again being repaired, further trials resulted in accident and failure, and it is reported that she has been rejected by the ministry of marine and returned to the builders.

The *Flibustier*, on her preliminary trial, made 25.5 knots.

Aluminum torpedo boat.—This boat was built by Messrs. Yarrow & Co., of Poplar, to the order of the French Government, by whom she has been designated as *C*. She is a third-class boat, and is one of nine which are to be carried by the torpedo-depot vessel *Foudre.* Her dimensions are: Length, 60 feet; beam, 9 feet 3 inches.

Pure aluminum has not been used in her construction, but certain alloys, among them copper (to the extent of about 6 per cent), have been introduced to give greater strength and stiffness to the metal. The stem and stern frames are of galvanized steel, and the smoke pipe, also of steel, has an aluminum casing. The deck plates over the boilers are likewise of steel. On her official trial this boat made 20.503 knots with an average steam pressure of 180 pounds; air pressure, 1.75 inches; revolutions, about 590. It is reported that the French Government are so well satisfied with *C* that orders have been placed for five more aluminum boats of the same type.

Other experiments with aluminum have given very different results. Indeed, it now seems to be the general opinion that this metal is unfit for use in its pure or slightly alloyed state. It is easily corroded by salt air, even through paint, and it lacks stiffness, ductility, and reliability. Its future is apparently chiefly in its alloys.

Loss of torpedo boat No. 20.—This small second-class boat capsized on May 16, two miles NNW. of the Isle of Aix. The lieutenant commanding and four of the crew were drowned. She was struck by a heavy sea and turned completely over. She then partly righted and, while lying thus upon her side, all of the crew got out of her; but, as noted above, five lives were lost before the arrival of another boat which was in company. The boats of the type to which *No. 20* belonged had all been severely tried in rough weather and were considered excellent sea boats.

SUBMARINE BOATS.

GUSTAVE ZÉDÉ.

(Page 40, No. X; 54, No. XIII.)

Further trials of this boat were begun in November, 1894, three hundred new accumulators having been installed. Her turning circle was found to be about 700 feet. During one of her trials it appears that, although the boat was probably not submerged for more than a minute, those on board experienced some discomfort from the acid vapors disengaged in the accumulators, so that submersion for more than a few minutes would be impossible unless measures could be devised for correcting the inconvenience complained of. New accumulators were then installed, the air supply to the crew increased, and other improvements made in the ventilation. Upon the last trial, after these and other changes had been made, it was found that the discomfort previously experienced, chiefly caused by overworking the storage batteries, was very much lessened. It is therefore hoped that the trouble may be eventually overcome. The speed realized on this trial, when wholly submerged, was 8.25 knots.

GOUBET.

(Page 454, No. VIII; 33, No. IX; 40, No. X; 40, No. XI.)

The submarine boat *Goubet* has never been purchased by the Government. It is reported that she has been seized by the creditors of M. Goubet.

VESSELS LOST, SOLD, OR STRUCK FROM THE LIST.

Chacal, gun vessel, sold; *Champlain*, wood cruiser, sold; *Drac*, transport, sold; *Européen*, transport, struck from the list; *Galissonière*, armored cruiser, sold; *Marengo*, old-type battleship, sold; *Ocean*, old-type battle ship, sold; *Sâone*, transport, transformed into floating barrack; *Trombe*, river gunboat, struck from the list.

GERMANY.

The German budget for 1895–96 provides for the construction of one first-class battleship to replace the *Preussen* (second payment); one first-class armored cruiser, of 7,500 to 9,000 tons, to replace the *Leipzig;* three second-class protected cruisers of improved *Gefion* type; also for refit of the battleships *König Wilhelm*, *Friedrich der Grosse*, and *Deutschland*, and very extensive refit of the battleships *Sachsen*, *Baiern*, *Baden*, and *Württemberg.*

The total amount of the budget for the year ending March 31, 1896, is 83,567,384 marks ($19,889,037.41), an increase of $2,295,370 over the budget for 1894–95. The sum allotted to wholly new construction is $1,666,000, while a credit of $1,717,408 is to be devoted to vessels building. Additional sums are allotted for armament and equipment and refits and repairs of old vessels.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

BATTLE SHIP (ERSATZ PREUSSEN.)

The keel of the new first-class battleship built to replace the *Preussen* was laid in the Government yard at Wilhelmshaven, where her machinery will also be built, April 5, 1895. In general design she will be identical with the *Wörth* class, but will differ in certain details. The armor will be face-hardened. The estimated cost of the hull, including armor, is $3,360,000; ordnance (main battery), $1,190,000; torpedo installation, $122,000. She is to be finished in four years.

FIRST-CLASS ARMORED CRUISER.

This vessel, temporarily styled *ersatz Leipzig*, will have an armored belt and deck and a battery of new type and rapid-fire guns. The displacement will be 7,500 to 9,000 tons.

PROTECTED CRUISERS K, L, AND ERSATZ FREYA.

These cruisers are to be of improved *Gefion* type.

VESSELS LAUNCHED.

ODIN (V) AND AEGIR (I).

(*See Siegfried*, etc., page 266, No. VI; 315, No. VII; 354, No. VIII; 40, 41, No. IX.)

These two vessels are the seventh and eighth of the *Siegfried* class to take the water. The remaining two, *W* and *X*, have not yet been laid down, and possibly may not be. The *Odin* was launched at Dantzic, November 5, 1894, and the *Aegir* at Kiel, April 3, 1895.

The launchings of the other vessels of the class have taken place as follows: *Siegfried*, at Kiel, in 1889; *Beowulf* and *Frithiof*, at Bremen, in 1890 and 1891, respectively; the *Heimdall*, at Wilhelmshaven, in 1892, and the *Hildebrand* and *Hagen*, at Kiel, in 1892 and 1893, respectively. These vessels were originally designed as coast-defense ships and were built for the protection of the entrances of the recently opened Kaiser Wilhelm (North Sea–Baltic) Canal. Their seagoing qualities having proved to be excellent, they are now regarded as fourth-class battleships.

The first six of the *Siegfried* class are alike in dimensions and design. The last two, the *Odin* and *Aegir*, are slightly different. The principal characteristics of the first six are:

Armament.—Three 24-centimeter (9.45-inch) L/35 Krupp guns, two forward, one at each end of the thwartship barbette redoubt, and one in a pear-shaped barbette tower aft; eight (the *Siegfried* has only six) 8.8-centimeter (3.46-inch) L/30 R. F. G., in sponsons projecting from the superstructure. There are, in addition, six 8-millimeter machine guns and four torpedo tubes.

Protection.—Complete water-line belt, 7 feet 6 inches broad, 9.45 inches thick amidships, and 5.9 inches at the ends; elongated armored barbette redoubt, with parallel forward and after sides and semicircular ends, extending athwartship, the ends supported by sponsons; thickness of the armor on this redoubt, 7.87 inches; pear-shaped barbette tower aft of the same thickness; hoods over heavy guns, 4 to 5.5 inches thick; shields over R. F. G.; complete protective deck, 1.2 to 1.4 inches thick at top of belt. Armored conning tower.

Motive power.—Twin-screw engines of 4,800 I. H. P., designed to give a speed of 16 knots. This speed has not in any case been reached. (*See* Steam Trials, *Hagen, Heimdal, Hildebrand.*)

Dimensions.—Length, 239.5 feet; beam, 48.75 feet; mean draught, 17.4 feet; extreme draught, 17.75 feet; displacement, 3,440 tons.

The *Odin* and *Aegir* differ from the first six, described above, in the following particulars:

In armament.—The *Aegir* mounts ten 8.8-centimeter R. F. G. in the superstructure.

In protection.—The *Odin* and *Aegir* have partial belts only, extending along about 60 per cent of the water line; the sides, ends, and sponsons of the superstructure are armored.

In motive power.—The engines of the *Odin* and *Aegir* are of 5,000 I. H. P., to give the same speed with their increased size.

In dimensions.—(Both *Odin* and *Aegir.*) Length, 253.33 feet; beam, 48.75 feet; draught, 17.75 feet; displacement, 3,600 tons.

The description of the *Hagen* (p. 54, No. XIII) was taken from a German newspaper; where it is inconsistent with the foregoing, it is believed to be incorrect. The guns of all the class are to be mounted as here described and not as stated in No. XIII.

GEIER.

This unprotected cruiser of 1,880 tons was launched at Wilhelmshaven October 15, 1894. She is a sister ship of the *Cormoran, Condor,* and *Seeadler.* (*See* p. 42, No. XII.)

HELA (H).

This dispatch vessel was launched at the yard of the Weser Actien Gesellschaft, Bremen, March 28, 1895. Her principal characteristics are:

Armament.—Four 8.8-centimeter (3.47-inch) R. F. G.; five 5-centimeter (1.97-inch) R. F. G.

Dimensions.—Length, 328 feet; beam, 36 feet; displacement, 2,000 tons.

The estimated speed is 20 knots.

STEAM TRIALS.

BRANDENBURG, KURFÜRST FRIEDRICH WILHELM, WÖRTH, AND WEISSENBURG.

(Page 354, No. VIII; 47, No. XI; 156, No. XII; 55, No. XIII.)

These battleships have all been completed and commissioned. The results of the trials are as follows:

Wörth.—Forced-draft trial: I. H. P., 10,087; revolutions, 111; speed, 17.2 knots. The trial took place in a depth of 30 fathoms of water; as this depth was decreased to 20 and 10 fathoms, the speed fell to 16.7 knots and 16.6 knots, respectively.

Weissenburg.—Speed on forced-draft trial, 17 knots; I. H. P., 10,000.

Brandenburg.—Speed on forced-draft trial, 16.5 knots; I. H. P., 9,640.

Kurfürst Friedrich Wilhelm.—Speed on forced-draft trial, 17 knots; I. H. P., 9,959.

HAGEN, HILDEBRAND, AND HEIMDALL.

(*See Odin* and *Aegir,* under Vessels Launched.)

The following is a tabular statement of the results of the trials of these vessels:

Name.	Character of trial.	Mean draught on trial.		Displacement on trial.	Steam pressure.	Air pressure.	I. H. P.	Speed.	Revolutions.	Coal used per hour.
		Ft.	*in.*	*Tons.*	*Pounds.*	*In.*		*Knots.*		*Tons.*
Hildebrand ..	3-hour forced draft..	17	5	3,492	173.5	1.7	4,693	14.73	135.8	3.55
	6-hour forced draft..	17	4	3,462	173.5	1.8	4,413	....	134.9	4.24
	24-hour coal-endurance trial.	17	4	3,462	166.4	1.12	3,472	14.24	126.2	3.504
	24-hour coal-endurance trial at reduced speed.	17	4½	3,470	169.3	.28	761	9.29	76.4	.943
Heimdall.....	6-hour forced draft..	18	0.5	3,646	166.4	1.71	4,393	14.62	132.9	4.11
	24-hour coal-endurance trial.	18	0	3,642	167.8	1.18	3,181	14.05	124.1	2.88
	24-hour coal-endurance trial at reduced speed.	17	6	3,505	147.9	.28	772	9.59	78	.88
Hagen	6-hour forced draft..	17	4.5	3,477	174.9	1.83	4,516	14.85	136.2	4.11
	24-hour coal-endurance trial.	17	6.5	3,518	169.3	1.20	3,322	14.21	124.1	2.98

The rapid rise in power as the speed approaches 15 knots seems to indicate that none of these vessels are likely to exceed that speed, even if their machinery should develop the designed 4,800 I. H. P.

GEFION.

This protected cruiser completed her trials during the summer of 1894 with the following results:

Character of trial.	Mean draught.		Displacement.	Speed.	I. H. P.	Steam pressure.	Air pressure.	Revolutions	Coal burned per hour.
	Ft.	*in.*	*Tons.*	*Knots.*		*Pounds.*	*In.*		*Tons.*
6-hour forced draft.............	20	1	4,073.5	20.022	9,244	171.4	0.53	138.5	6.14
24-hour continuous run with natural draft.................	19	9.5	3,984.8	18.206	6,462	170.7	......	124.4	5.11
24-hour endurance trial at reduced speed with natural draft, 2 boilers only	20	0.5	4,063.9	11.18	1,151	102.1	......	72.3	1.236
Forced-draft trial over measured mile	19	9.2	3,975.3	20.528	9,828	167.8	.67	141.9	....

The *Gefion* was laid down at the yard of the F. Schichau Company, Dantzic, in March, 1892, and launched May 31, 1893. The hull is of steel, sheathed with wood and coppered. There are three smoke-pipes. Three pole masts are fitted with one very small top on each. The foremast has a lookout station in addition. The principal characteristics are:

Armament.—Ten 10.5-centimeter (4.13-inch), L/35, R. F. G.; six 5-centimeter (1.97-inch), L/40, R. F. G.; one 6-centimeter (2.36-inch) boat gun; two 17.7-inch training torpedo tubes.

Protection.—Complete protective deck, 0.98-inch thick on the flat and 1.18 inches thick on the slope; cofferdam. Over the parts of the engine cylinders extending above the protective deck a cap of 0.6-inch steel plating is fitted; this is in turn surrounded by nickel-steel armor backed by 5.9 inches of wood. Gun shields.

Motive power.—Twin-screw, triple-expansion engines of 9,828 I. H. P. (*See* Trial Results), designed to give a speed of 20 knots with forced draft and 18 knots (for 24 hours) with natural draft. There are six boilers. The capacity of the coal bunkers is 770 tons. From data obtained on trial, this should give a steaming radius of 6,850 nautical miles at 11 knots, or 2,730 miles at 18 knots.

Dimensions.—Length, 344.5 feet; beam, 43.33 feet; mean draught, 20.4 feet; displacement, 4,141 tons (or 4,207 metric tons).

VESSELS RE-ARMING, REFITTING, ETC.

SACHSEN, BAIERN, BADEN, AND WÜRTTEMBERG.

The four battleships of this class are to receive a very thorough refit, which will include new engines and boilers of modern type, and general overhauling and repairing of the hull and fittings. The work is to be completed in three years, at a cost of 1,560,000 marks ($371,280) for each ship. The total cost, including the trial trips, will be 6,560,000 marks ($1,561,280). The whole work is to be done in the Government yards at Kiel and Wilhelmshaven.

KAISER, OLDENBURG.

The old-type battleship *Kaiser* has been refitted. The old masts and rigging have been removed and two military masts substituted. She has received a new battery of rapid-fire guns, as has also the battle ship *Oldenburg.*

TORPEDO BOATS.

During the spring and summer of 1895 ten new boats will be delivered to the Government by the F. Schichau Company of Elbing, division boat D^9 and first-class boats S^{74} to S^{81}, while division boat D^{10} is under construction at the same yard and will be delivered later in the year. All these boats are larger than their predecessors, having greater displacement, higher speed, and better accommodation for the crews. The new division boats have three boilers instead of two, and first-class boats two instead of one. *D^9* has already had her preliminary trials. During a 5-hour run in a rough sea, at load draught, the average speed was 23.67 knots. She has a displacement of 380 tons and engines of 4,500 I. H. P. The armament consists of six small R. F. G. and three torpedo tubes. The radius of action is about 5,000 miles.

When all the torpedo boats in course of construction are completed, Germany will have 10 division boats of 250 to 380 tons and 112 first-class boats. German torpedo boats will be armed in future with 3-pounder R. F. G. and 8-millimeter (0.315-inch) machine guns. All Hotchkiss revolving cannon now carried will be removed as fast as possible and the new armament substituted.

GREAT BRITAIN.

The naval estimates for 1895–96 amount to a net total of £18,701,000 ($91,012,156.70), or £1,334,900 ($6,496,557.83) more than the sum voted for 1894–95. The increase is due to new construction, increased progress on ships already laid down, increased personnel, new naval works, improvement and increase of the naval reserve, and increased amounts of coal and other supplies.

The program of new construction includes 4 protected cruisers of about 11,000 tons; 4 protected cruisers of about 5,750 tons; 2 cruisers of about 2,100 tons; 20 first class torpedo boats, so-called "destroyers;" 10 first-class torpedo boats of smaller size.

During the fiscal year 1895–96 the following vessels will be under construction: In Government yards, 8 first-class battleships, 8 first-class cruisers, 2 second-class cruisers, 4 sloops; in private yards, 2 first-class battleships, 11 first-class cruisers, 45 to 50 first-class torpedo boats.

The total number of officers, seamen, boys, coast guard, and marines for the year is placed at 88,500; an increase of 5,450 over last year.

The following table shows the number of new vessels on which work will be done during the year 1895–96:

Type.	To be commenced.	Building.	To be completed.
Battleships, first class		10	
Protected cruisers, first class	8	8	
Protected cruisers, second class	2		
Sloops, unprotected			4
Torpedo boats, first class (Havock type)	20		24
Torpedo boats, first class (smaller type)	10		

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

ANDROMEDA, DIADEM, EUROPA, AND NIOBE.

Work on these four first-class protected cruisers will be commenced during the year. The keel of the *Andromeda* will be laid in the Government yard, Pembroke, on the slip vacated by the *Renown.* The other three will be built by contract in private yards. Externally these vessels will resemble the *Royal Arthur* class in having a considerable height of freeboard, with a long forecastle. The hulls will be of steel, sheathed with wood and coppered. The principal characteristics of the vessels are:

Armament.—Fifteen 6-inch guns; fourteen 12-pounder R. F. G.; several machine guns. Two submerged torpedo tubes in the side and one stern tube will be fitted.

Protection.—They will resemble the *Terrible* (*see* Vessels Launched) in the protection of the armament and arrangement for the transport of ammunition to the fighting stations.

Motive power.—Twin-screw, triple-expansion engines of about 20,000 I. H. P.; Belleville water-tube boilers; estimated speed with forced draft, 20.5 knots; continuous sea speed in smooth water with clean bottoms, 19 knots. Capacity of coal bunkers, about 2,000 tons, about 1,000 tons of which is carried at the load draught and displacement given below.

Dimensions.—Length between perpendiculars, 435 feet; length on load water line, 455 feet; beam, 69 feet; mean draught with keel, 25.25 feet; displacement, about 11,000 tons at this draught.

ARROGANT, FURIOUS, GLADIATOR, AND VINDICTIVE.

These first-class protected cruisers (English classification second class), as stated in the estimates, will be built in the Government yards, the *Arrogant* and *Furious* at Devonport, the *Gladiator* at Portsmouth, and the *Vindictive* at Chatham. The hull will be of steel, without sheathing. In arrangement of the upper works they will resemble the *Talbot* class. The principal characteristics are:

Armament.—Four 6-inch guns; six 4.7-inch R. F. G.; eight 12-pounder R. F. G.; one 12-pounder R. F. G. of 8 hundredweight (boat gun); three 3-pounder R. F. G.; five Maxim machine guns. Two submerged-torpedo tubes will be fitted, one each side.

Protection.—Same as *Talbot* class. (*See* Vessels Launched).

Motive power.—Twin-screw, triple-expansion engines, designed to develop 10,000 I. H. P. with natural draft; corresponding estimated speed, 19 knots. Belleville water-tubulous boilers.

Dimensions.—Length on water line, 320 feet; beam, 57 feet; mean draught, 22 feet; displacement, 5,750 tons.

PELORUS AND PROSERPINE.

These second-class cruisers will be laid down at Sheerness during the summer of 1895. They are referred to as improved *Barhams.* (*See* p. 302, No. VIII.) The principal characteristics are:

Armament.—Eight 4-inch and eight 3-pounder R. F. G. and torpedo tubes.

Motive power.—Twin-screw, triple-expansion engines of about 7,000 I. H. P.; estimated speed, 20 knots; Belleville water-tubulous boilers.

Dimensions.—Length on water line, 300 feet; beam, 36.5 feet; mean draught, 13.5 feet; displacement, 2,100 tons.

The keels of the following-named vessels have been laid since date of last annual:

Name of ship.	Type.	Where laid	Date.
Cæsar	Battleship	Portsmouth Navy-Yard	Mar. 25, 1895
Illustrious	do	Chatham Navy-Yard	Mar. 13, 1895
Hannibal	do	PembrokeNavy-Yard	May 1, 1894
Victorious	do	Chatham Navy-Yard	May 28, 1894
Prince George	do	Portsmouth Navy-Yard	Sept. 10, 1894
Mars	do	Messrs. Laird Bros., Birkenhead	June 2, 1894
Jupiter	do	Messrs. J. & G. Thomson, Clydebank	Apr. 26, 1894
Powerful	Armored cruiser, first class.	Naval Construction and Armaments Co., Barrow-in-Furness.	Mar. 10, 1894
Terrible	do	Messrs. J. & G. Thomson, Clydebank	Feb. 21, 1894
Venus	Protected cruiser	Fairfield Shipbuilding and Engineering Co., Govan.	June 28, 1894
Diana	do	do	Aug. 13, 1894
Juno	do	Naval Construction and Armaments Co., Barrow.	June 22, 1894
Doris	do	do	Aug. 29, 1894
Isis	do	London and Glasgow Shipbuilding Co., Glasgow.	Jan. 30, 1895
Dido	do	do	Aug. 30, 1894
Algerine	Gun vessel	Devonport Navy-Yard	July 25, 1884
Phœnix	do	do	July 26, 1894

Descriptions of all of the above-named vessels, or of their sister ships, are given under "Vessels Launched." The battle ships are similar in all respects to the *Magnificent* and *Majestic;* the *Terrible*, *Powerful*, *Algerine*, and *Phœnix* are described under their own names; while the other six cruisers of the table are practically sister ships to the *Talbot* and *Eclipse*, differing only in having 6 inches more beam.

VESSELS LAUNCHED.

MAGNIFICENT AND MAJESTIC.

(Page 9, No. XI; 146, No. XII; 14, No. XIII.)

The first-class battleship *Magnificent* was floated out of dock at Chatham December 19, 1894; the *Majestic*, at Portsmouth, January 31, 1895.

The interval between the laying of the keel and the floating was, for the *Magnificent*, 372 days; for the *Majestic*, 360 days.

The principal details of these ships are as follows:

Armament.—Four 12-inch L/35 wire-wound guns, in pear-shaped barbette towers, forward and aft; twelve 6-inch guns, eight in armored casemates on the gun deck and four in armored casemates on the main deck, at the corners of the central superstructure; sixteen 12-pounder R. F. G., twelve in broadside in the superstructure on the upper deck between the 6-inch guns, and one on each side of the forward and after bridges; twelve 3-pounder R. F. G., two in each lower military top, two in the forward upper top, two forward and two aft in recessed ports on the gun deck, and two on the forward bridge. There is an axial ammunition hoist in the barbette towers, so that ammunition can be brought up for hand loading in any position of train. This is in addition to the hoist in the fixed loading station. For the supply of the 6-inch guns there are two long passages above the engine and fire rooms, one on each side of the ship, extending fore and aft, to give access to the magazines and shell rooms. These passages are below the protective deck and suspended from it. Separate magazines and shell rooms are built for each class of gun at each end of the ship.

Five torpedo tubes are fitted, one above-water tube in the stern and four submerged tubes.

Protection.—Partial belt of Harvey face-hardened steel armor, 14 feet 9 inches wide (about 5.5 feet below and 9.5 feet above the water line), 216 feet long, and of a uniform thickness of 9 inches. Armor bulkheads, 9 to 14 inches thick. Twelve casemates 6 inches thick for 6-inch guns. Middle protective deck, beginning at lower edge of belt and curving up to meet the flat, which is about 2 feet above water; thickness on slopes, 4 inches; thickness on flat, 3 inches. The forward and after protective decks (beyond the belt) are nearly flat, the forward one dipping down to meet the ram; thickness, 2.5 inches. Conning tower, forward, 14 inches thick; director tower, aft, 3 inches thick. The barbette towers for the 12-inch guns are built up from the ends of the middle protective deck; thickness, 14 inches. There are also armored shields over the barbette guns. The ends of the belt are joined to the barbette towers by 9-inch bulkheads. The support to the side armor consists of 4 inches of teak backing; two thicknesses of skin plating; web frames back of the plating, 15 inches deep, strengthened by reverse angles and spaced 2 feet apart. These frames extend vertically from the protective deck past the berth deck to the gun deck, being attached to the deck beams by large bracket plates. The openings in the protective deck are protected by armor gratings. All of the 9-inch and 14-inch armor is Harvey face-hardened. The triangular space between the protective deck slope and the armor belt is filled with water-excluding material.

Motive power.—Twin-screw triple-expansion engines, with cylinders of 40, 59, and 88 inches diameter and 51 inches stroke. The estimated

I. H. P. is 12,000 with forced draft and 10,000 with natural draft, the corresponding estimated speeds being 17.75 and 16.5 knots. The boilers are eight in number, of the ordinary marine type, 16.1 feet in diameter, 9.25 feet long, and each having four furnaces. The working pressure will be 150 pounds per square inch. The propellers are of bronze, 17 feet in diameter, with a pitch of 19.75 feet. The coal supply at load draught is 900 tons; total capacity, 1,800 tons.

Dimensions, weights, etc.—Length on water line, 390 feet; beam, 75 feet; draught forward, 27 feet; draught aft, 28 feet; displacement at this draught, 14,900 tons. Free board forward, 25 feet; aft, 18.5 feet; along middle body, 17.75 feet. Weight of hull, armor, and backing, 10,180 tons; armor, 2,980 tons; steel in hull, 4,340 tons; wood decks, etc., 570 tons; backing, 160 tons; fittings, 850 tons; protective material, 1,410 tons; equipment, 600 tons; armament, 1,500 tons; machinery, 1,300 tons; coal, 900 tons.

RENOWN.

(Page 9, No. XI; 149, XII.)

This battleship was launched at Pembroke dockyard May 8, 1895. The hull is of steel, sheathed with teak and coppered. Like all recent British battleships, she has two smoke pipes of oval section placed abreast. There are two military masts, each carrying two tops, but no guns are mounted in the upper top on the after mast, which is arranged for a search light. The principal characteristics are as follows:

Armament.—Four 10-inch 29-ton guns, mounted for high angle fire by pairs in circular barbette towers forward and aft; ten 6-inch guns, six in casemates on the gun deck in broadside and four on the main deck in the corners of the superstructure, protected by quadrantal armored shields forming that part of the superstructure bulkhead; eight 12-pounder R. F. G. in broadside on the main deck between the 6-inch guns; twelve 3-pounders, of which four are on the gun deck, two forward, two aft, in recessed ports; seven Maxim machine guns. Five torpedo tubes are fitted, one in the stern above water and four submerged, two each side; twenty-two torpedoes are to be carried.

Protection.—The side armor and the thwart-ship armored bulkheads at its ends form a central armored citadel. The lower strake of belt armor, which rises some distance above the water line, is 8 inches thick. Above this is a strake of 6-inch armor reaching to the under side of the gun deck. The armored bulkheads at the ends of these strakes are 10 and 6 inches thick. The middle protective deck, like that of the *Magnificent* class, rises from the lower edge of the side armor to meet a broad, flat portion amidships. The thickness on the slopes is 3 inches and on the flat 2 inches. The protective deck forward and abaft the citadel is flat (except that it curves down to meet the ram) at the level of the lower edge of the side armor, and is 2 inches thick. The barbette towers are circular, with armor 10 inches thick, and are surmounted by revolving armored shields. The 6-inch guns are all protected by armor on their casemates.

Motive power.—The machinery is practically identical with that of the *Magnificent* class, consisting of 3-cylinder, triple-expansion engines designed to develop 12,000 I. H. P. with forced draft and 10,000 with natural draft. The corresponding speeds are 18 and 17 knots. The boilers are eight in number, of the ordinary single-ended marine type.

Dimensions.—Length between perpendiculars, 380 feet; beam, extreme, 72.33 feet; load draught, 26.75 feet; displacement, 12,350 tons. The complement of officers and men is 674.

TERRIBLE.

(Page 15, No. XIII.)

The lightly armored cruiser *Terrible* was launched at the yard of Messrs. J. & G. Thomson, Clydebank, Scotland, May 27, 1895. This vessel and her sister ship, the *Powerful*, are in England officially styled "protected cruisers," but considering the amount of armor they carry they ought properly to be called "armored cruisers." The hull is of steel, sheathed with a single thickness of 4 inches of teak and coppered. The usual double bottom is fitted, and the total number of water-tight compartments in the hull is 256. There are four smoke pipes and two military masts, the latter carrying two tops each. The upper top on the mainmast is fitted for a search light; the others are for rapid-fire guns. The masts are 36 inches in diameter and are tubular, with inside hoists for the ammunition of the rapid-fire guns in the tops. There is a heavy derrick on the mainmast for hoisting in and out boats. The largest boat carried is 56 feet long. The complement of officers and men is 894.

Armament.—The armament consists of two 9.2-inch, 22-ton guns, twelve 6-inch guns, eighteen 12-pounder R. F. G., twelve 3-pounder R. F. G.; nine machine guns, and two boat guns. The 9.2-inch guns are mounted singly in circular barbette towers—one forward, one aft. Eight of the 6-inch guns are mounted on the gun deck at a height of 14.5 feet above the water line; the two forward and two after guns can fire parallel with the keel; the other four are in broadside, with arcs of fire of about 60 degrees forward and abaft the beam. The remaining four 6-inch guns are on the main deck; the forward two can fire directly ahead and the after two directly astern, like the forward and after guns of the same caliber on the deck below. Four of the 12-pounders are on the gun deck in recessed ports with similar arcs of fire. On account of the very fine lines of the hull the ports are of very unusual length, the forward ones being 18 and the after ones 16 feet long. The arc of fire is from directly ahead or astern to 30 degrees beyond the beam. Four more of the 12-pounders, with similar arcs of fire, are mounted on the main deck; the remainder are on the main deck in broadside. Two 3-pounders or machine guns are mounted in each top on the foremast and two in the lower top on the main.

The ammunition rooms and magazines are all below the protective deck. There is a fore-and-aft ammunition passage on each side of the ship, directly under the protective deck and suspended from it. This passage extends through the coal bunkers. In it are trolleys for the carriage of the 6-inch ammunition from the magazines to a point directly under each gun, whence it will be hoisted through an armored tube to the casemate containing the gun. There are similar passages above the protective deck for supplying the 12-pounder and smaller guns. The 9.2-inch guns are supplied by ammunition hoists in armored tubes extending from the barbette towers directly to the magazines.

Four under-water torpedo tubes are fitted. They are on the platform deck—two forward, two aft.

Protection.—The protective deck has a very high arch with a comparatively narrow flat. It extends, along the middle body, from 7 feet below to 3.5 feet above the water line. The thickness is 4 inches on the slopes over the boiler and engine spaces and 3 inches forward and abaft. It is formed of three thicknesses of mild steel plates. Further side protection is afforded by the coal bunkers, which extend the full length of the machinery space (252 feet). The circular barbette towers of the 9.2-inch guns are 6 inches in thickness; loading tube, 3 inches. Each 6-inch gun is mounted in a pentagonal-shaped armored casemate and projects through a plate of 6-inch Harvey face-hardened armor. The conning tower, situated on the forecastle, is circular in plan, with an internal diameter of 9.5 feet, and is built up of 12-inch Harvey face-hardened armor plates. The entrance is on the after side, behind a thick, curved armor shield. The armored communication tube, which extends from the conning tower to the protective deck, is 9 inches in internal diameter and 9 inches thick.

Motive power.—The engines are twin-screw, four-cylinder, triple-expansion. The cylinders are 45, 70, 76, and 76 inches in diameter and the stroke is 4 feet. The estimated I. H. P. with natural draft is 25,000 and the corresponding speed, with 110 revolutions, is 22 knots. There are forty-eight Belleville boilers, working pressure, 260 pounds; pressure at engines, 210 pounds; grate area, 2,200 square feet; heating surface, 67,800 square feet; cooling surface in condensers, 25,000 square feet. The total coal capacity is 3,000 tons, of which about 1,500 tons may be carried at mean-load draught.

Dimensions.—Length between perpendiculars, 500 feet; length over all, 538 feet; beam, 71 feet; depth to upper deck, 43.3 feet; weight of hull and armor, 8,480 tons; draught (deep load), 27 feet; displacement, 14,250 tons.

TALBOT AND ECLIPSE.

(Page 149, No. XIII.)

These two protected cruisers of 5,600 tons have been launched, the *Talbot* at Devonport dockyard, April 25, 1895, and the *Eclipse* at Portsmouth dockyard, July 19, 1894. They will be fitted with military masts carrying fighting tops, if found sufficiently stable to carry them. The complement of officers and men is 436. The principal characteristics are:

Armament.—Five 6-inch guns, six 4.7-inch R. F. G., eight 12-pounder R. F. G., one 3-pounder R. F. G., one 12-pounder R. F. field and boat gun, and four 0.45-inch Maxim machine guns. If military masts are fitted the number of light guns will be increased. One 6-inch gun is mounted on the midship line forward, one each side in the waist on sponsons, and two on deck aft. The 4.7-inch guns are mounted on the main deck in broadside. Two 12-pounders are on the forecastle, one each side; two aft, one each side; four on the broadside between the 4.7-inch guns.

Protection.—Protective deck, 2.5 inches thick on the slopes over the machinery spaces, tapering forward and abaft; conning tower, 6 inches; armored hatch plates, 5 inches; gun shields.

Motive power.—Twin-screw, triple-expansion engines of 9,600 I. H. P. with forced draft; corresponding estimated speed, 19.5 knots. Total coal capacity, 1,076 tons.

Dimensions.—Length between perpendiculars, 350 feet; beam (extreme), 53.5 feet; draught forward, 19.5 feet; draught aft, 21.5 feet; displacement, 5,600 tons.

PHŒNIX AND ALGERINE.

(Page 16, No. XIII; *see also* table of vessels, with date of laying of keels, under the head of Vessels Proposed, etc., preceding.)

These vessels, which are sister ships in all respects, have been launched at Devonport dockyard, the *Phœnix* on April 25, 1895, and the *Algerine* on June 6 following. They are intended for foreign service, and the hull is of steel, sheathed with teak and coppered. The complement of officers and men is 106.

Armament.—Six 4-inch R. F. G.; four 3-pounder R. F. G.; three 0.45-inch Maxim machine guns.

Motive power.—Twin-screw, triple-expansion engines of 1,400 I. H. P.; estimated speed with natural draft, 12 knots. Total coal capacity, 160 tons.

Dimensions.—Length between perpendiculars, 185 feet; beam, extreme, 32.5 feet; draught forward, 11 feet; draught aft, 11.5 feet; displacement, 1,050 tons.

ALERT AND TORCH.

(Page 150, No. XII.)

These two gun vessels of 960 tons were floated out of dock at Sheerness dockyard December 28, 1894. (*See* Steam Trials.)

STEAM TRIALS.

FOX, FLORA, AND FORTE.

(Page 14, No. IX; 14, No. X; 153, No. XII; 29, No. XIII.)

Protected cruisers of 4,360 tons. After numerous unsuccessful attempts (especially of the *Fox*) these vessels have had trials which were regarded as satisfactory.

The final "natural-draft" (so called) trials of the *Fox*, on September 28, 1894, gave: Steam at boilers, 143 pounds; air pressure, 0.3 inch; vacuum, 25.5 inches; revolutions, 130; I. H. P., 7,034; speed by patent log, 19 knots. Her final forced-draft trial took place on October 16, 1894, and the results were: Boiler pressure, 144.8; air pressure, 1.3 inches; vacuum, 25.2 inches; revolutions, 140.8; I. H. P., 9,063; speed by patent log, 19.9 knots.

The final trials of the *Flora* gave: With natural draft, 7,187 I. H. P. and 19.18 knots speed by patent log; with forced draft, 9,297 I. H. P. and 20.1 knots speed by patent log.

The final trials of the *Forte* gave: With natural draft, 7,136 I. H. P. and 18.7 knots speed by patent log; with forced draft, 9,380 I. H. P. and 19.85 knots speed by patent log

These vessels were not down to their designed mean load draught of 19 feet. The average mean draught on trial was about 18 feet. The speeds, being obtained from the patent log alone, are only approximate.

DRYAD, HALCYON, HARRIER, HAZARD, AND HUSSAR.

(Page 10, No. XI; 34, No. XIII.)

These torpedo vessels of 1,070 tons have all had one or more unsatisfactory trials, chiefly owing to leaky boiler tubes. The results of the final trials are as follows:

Name.	Forced draft.		Natural draft.	
	I. H. P.	Speed.	I. H. P.	Speed.
		Knots.		*Knots.*
Dryad	3,709	18.5	2,621	16.85
Halcyon	3,546	17.7	2,584	16.9
Harrier	3,592	19.2	2,696	18
Hazard	3,714	19.25	2,604	17.1
Hussar	3,525	18.5	2,615	17

It will be observed that the speed of the *Halcyon* with forced draft is considerably below that of the others. An examination of the bottom in dry dock showed it to have been so roughly constructed that it was the reported intention of the Admiralty to sheath her as the only remedy; but this plan appears to have been given up. The so-called "natural-draft" trials, whose results are recorded above, were made with an air pressure in the fire rooms of 0.6 to 1.2 inches. On none of the trials were the vessels down to their mean load draught, but the *Harrier* made her trials at considerably lighter draught than the others.

ALERT.

(Page 150, No. XII; *see also* Vessels Launched.)

The steam trials of the gun vessel *Alert*, 960 tons, took place in April, 1895. The results of the 8-hour natural-draft trial were: Revolutions, 178; air pressure, 0.3 inch; I. H. P., 1,156; speed by patent log, 13 knots. The forced-draft trial gave: Revolutions, 202.8; I. H. P., 1,484; speed, 13.42 knots.

VESSELS RE-ARMING, REFITTING, ETC.

MONARCH.

This old battleship of 8,320 tons has recently been thoroughly repaired and refitted, and partially rearmed. New boilers and engines were supplied, together with much auxiliary machinery, new electric plant, etc. The main battery remains unchanged, but fourteen rapid-fire guns have been mounted. The old masts, spars, and rigging were removed and three military masts substituted. A number of additional water-tight bulkheads have been built to reduce the size of some of her compartments.

Her steam trials took place in October, 1894, with the following results:

	Mean draught.	Steam pressure.	Air pressure.	Revolutions.	I. H. P.	Speed.
	Feet.	*Pounds.*	*Inches.*			*Knots.*
Natural-draft trial, October 16	23.7	148.2	....	82.47	6,822	13.3
Forced-draft trial, October 18	23.5	152.6	0.6	86.56	8,216	14

SULTAN.

This old battleship of 9,290 tons was wrecked in Comino Channel, near Malta, about six years ago. She was raised and brought to England and thoroughly refitted. New decks, topsides, and quarters have been fitted; military masts have been substituted for her old masts and spars; a number of rapid-fire guns have been added to her original armament; and new boilers and triple-expansion engines replace her old propelling machinery. Her steam trial on June 6, 1895, gave the following results: Steam at boilers, 147.7 pounds; revolutions, 88.7; I. H. P., 6,531; speed by patent log, 14.6 knots. The entire cost of the refit was about $1,000,000.

VESSELS LOST, SOLD, OR STRUCK FROM THE LIST.

Algerine, gun vessel, sold; *Assistance*, troop ship, to be sold; *Euphrates*, troop ship, sold; *Euryalus*, cruiser, sold; *Foxhound*, gunboat, to be used to support boom defense at Southampton; *Locust*, tug, to be sold; *Nettle*, hulk, to be dispensed with, as armor is to be tested hereafter at Whale Island; *Rover*, cruiser, sold; *Tamar*, troop ship, to be sold; *Serapis*, troop ship, sold.

TORPEDO BOATS.

NEW FIRST-CLASS BOATS.

These boats will be of improved *Havock* type (p. 39, No. XIII), and the contract speed is 30 knots. Eight have been ordered, four from Messrs. Laird Brothers, of Birkenhead, and four from Messrs. J. I. Thorneycroft & Co., of Chiswick. Three each were at first ordered from

Messrs. Laird, Thorneycroft, and Yarrow, but the last-named firm declined the order. Two more will probably very soon be ordered from Messrs. J. & G. Thomson, of Clydebank. Ten more of the same class will be given out to contract during the year. It is reported that, in order to get greater strength, the hulls of these boats will be constructed of nickel steel.

Ten smaller first-class boats are to be built, but have not as yet been ordered.

Nearly all the boats of the *Havock* class have been launched. The following table gives the results of the steam trials of all that have had official trials:

Name.	Builder.	Length.	Beam.	Draught.	Displacement.	I. H. P.	Mean trial speed.
		Feet.	*Feet.*	*Feet.*	*Tons.*		*Knots.*
Ardent	Thorneycroft	201.5	19	6.67	280	4,306	27.97
Banshee	Laird	210	19.5	5.7	265	....	27.6
Boxer	Thorneycroft	201.5	19	6.67	280	4,543	29.17
Bruiser	do	201.5	19	6.67	280	4,156	27.97
Contest	Laird	210	19.5	5.7	265	....	27.4
Daring	Thorneycroft	185	19	6.28	240	4,500	28.21
Decoy	do	185	19	6.25	240	3,900	27.64
Dragon	Laird	210	19.5	5.7	265	....	27.14
Ferret	do	194	19.25	5	220	4,490	27.51
Havock	Yarrow	180	18.5	6	215	3,500	26.78
Hornet	do	180	18.5	6	215	4,000	27.63
Lynx	Laird	194	19.25	5	220	....	27.01
Rocket	Thomson	200	19.5	5.25	235	4,200	27.7
Salmon	Earle	200	19.5	5.4	264	....	28
Shark	Thomson	200	19.5	5.25	235	4,250	27.5
Sturgeon	Nav. C. & A. Co.	195	20.5	....	240	....	27.75
Surly	Thomson	200	19.5	5.25	235	....	28.05

The gun armament of these boats, except the *Havock*, *Hornet*, *Ferret*, and *Lynx*, consists of one 12-pounder and five 6-pounders. The four just mentioned and the *Daring* and *Decoy* have two training tubes on deck and one fixed bow tube. The bow tube has not been placed in the later-built boats, as it was found that with their great speed the bow wave not only interfered with launching, but that the boats would overrun their torpedoes before the latter could gather full headway.

The boats of the *Havock* class are fitted with tubulous boilers of different types, as follows:

Yarrow: *Hardy*, *Haughty*, *Hornet*, *Opossum*, *Ranger*, *Salmon*, *Snapper*, *Spitfire*, *Sunfish*, and *Swordfish*. Thorneycroft: *Ardent*, *Boxer*, *Bruiser*, *Daring*, and *Decoy*. White: *Conflict*, *Teazer*, *Wizard*, and *Zebra*. Normand: *Banshee*, *Contest*, *Dragon*, *Ferret*, *Lynx*, *Rocket*, *Shark*, and *Surly*. Blechynden: *Skate*, *Starfish*, and *Sturgeon*. Reed: *Janus*, *Lightning*, and *Porcupine*.

The following boats have been fitted with locomotive boilers: *Charger*, *Dasher*, *Fervent*, *Hasty*, *Havock*, and *Zephyr*.

First-class boats *Nos. 91, 94, 95*, and *97* have completed their trials satisfactorily.

The trials of *No. 91* gave: Mean speed during six runs over the measured mile, 23.71 knots; mean speed during two consecutive runs, 24.72 knots; mean speed by patent log during 3-hour free route trial, 23.74 knots; maximum I. H. P. developed, 2,639. The principal characteristics are:

Armament.—Three torpedo tubes; three 3-pounder R. F. G.

Motive power.—Single-screw, triple-expansion engines, I. H. P., 2,400. Coal supply, 25 tons.

Dimensions.—Length, 142.5 feet; beam, 15.5 feet; extreme draught, 7.5 feet; displacement, 129 tons.

No. 94 made an average of 23.257 knots on trial, and *No. 95*, 23.21 knots.

The first trials of *No. 97* were unsatisfactory (*see* p. 44, No. XIII); later trials were successful. On the measured mile the results were: Steam pressure, 171 pounds; vacuum, 24.8 inches; revolutions, 361.1; I. H. P., 1,675; speed, 23.7 knots. The mean speed on the 3-hour trial was 23.35 knots.

ITALY.

The total amount of the naval estimates for 1895–96 is 92,863,748.28 lire ($17,922,703.42), which is $580,285.90 less than the amount of the budget for 1894–95. The sum of $4,400,400 is devoted to construction.

VESSELS PROPOSED, AUTHORIZED, AND BUILDING.

Provision is made in the estimates for continuing the work on vessels already under construction, viz:

Battleships: *Ammiraglio St. Bon* and *Emanuele Filiberto*. Armored cruisers: *Carlo Alberto*, *Vittor Pisani*, *Giuseppe Garibaldi*, and *Varese*. Protected cruisers: *Calabria* and *Puglia*. Gun vessel: *Governolo*. Several small vessels for local and harbor service are also provided for.

There are said to be in contemplation three battle ships of the *Emanuele Filiberto* type, and four cruisers or torpedo vessels. It is also stated that the minister of marine has approved the plans of two battle ships of novel design, in which high speed is combined with very low free board. It is improbable, however, that any of these projected vessels will be taken in hand during the present year.

The armored cruiser building by Messrs. Ansaldo Brothers under the name of the *Giuseppe Garibaldi* (*see* p. 61, No. XIII) has been sold to Argentina. The contract of the Italian Government with Messrs. Ansaldo called for the delivery of the *Garibaldi* in 1898, and a new vessel, similar in all respects, has been laid down in place of the one sold. The newly commenced ship will, it is expected, be delivered at the time originally contracted; and she, and not the vessel sold, will hereafter be known as the *Giuseppe Garibaldi*.

VESSELS LAUNCHED.

CALABRIA (F).

(Page 36, No. IX; 41, No. XI.)

This protected cruiser was launched at Spezia, September 20, 1894. The hull is of steel, sheathed with wood and zinc. Three pole masts, with light sail power, are fitted.

Armament.—Four 152-millimeter (6-inch) guns; six 120-millimeter (4.7-inch) R. F. G.; eight 6-pounder R. F. G.; twelve 1-pounder R. F. G.; two machine guns; two torpedo tubes.

Protection.—Protective deck, 1.97 inches thick on the slope over the middle body. Cofferdam for belt of obturating material. Gun shields.

Motive power.—Triple-expansion engines; four boilers in two compartments. I. H. P. of machinery, 4,000 with natural draft, and 6,500 with forced draft; corresponding estimated speeds, 18 and 19 knots.

Dimensions.—Length, 249.3 feet; beam, 41.99 feet; mean draught, 16.3 feet; displacement, 2,470 metric tons (2,431 tons of 2,240 pounds).

STEAM TRIALS.

SARDEGNA.

(Page 42, No. X; 62, XIII.)

The forced-draft trials of this battleship, which were interrupted on May 16, 1894, by the breaking down of her forced-draft fans, were satisfactorily completed on July 10 following. The results were: Mean I. H. P. during 3-hour run, approximately 15,000; maximum, 16,200; mean speed, 19.64 knots; maximum, 20.2 knots. The horsepower was not as high as that developed on her previous trial and the mean speed was less, though the maximum was slightly greater.

MARCO POLO.

(Page 41, No. XI; 158, No. XII.)

This lightly armored cruiser is reported to have finished her official trials, but the results have not been published.

VESSELS RE-ARMING, REFITTING, ETC.

ITALIA, LEPANTO, DANDOLO, AND DUILIO.

The investigation of the stability of battleships which has recently been going on in Europe as a result of the *Victoria* disaster and the *Magenta* inquiry has caused the Italian authorities to examine their vessels. The result of the examination is said to have caused them to decide on certain changes in the *Italia* and *Dandolo* classes. In the *Italia* and *Lepanto* the necessary changes were found to be few. The principal one will be the replacing of her old main battery by a new one of 34-centimeter (13.4-inch) 67-ton guns.

In the *Dandolo* and *Duilio* more radical alterations (*see* fig. 4) were considered desirable. In order to bring the belt armor up to its designed position a considerable reduction of weight was necessary.

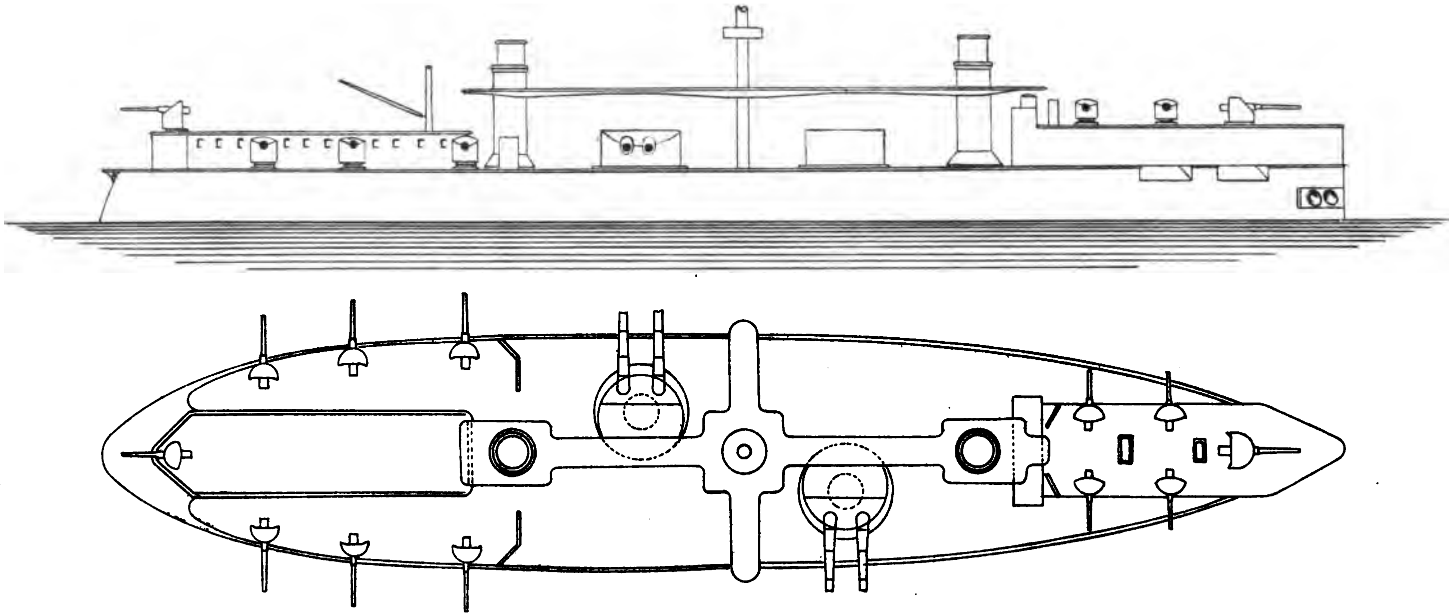

Fig. 4. ITALIAN BATTLESHIP DANDOLO.

RIVISTA MARITTIMA.

The old armament and its protecting turrets, operating machinery, ammunition and stores, weighing 1,953 tons, were removed. The new armament, with its turrets and other appurtenances, weighs but 960 tons. It consists of four new-type 10-inch and seven new-type 6-inch guns; five 4.7-inch R. F. G.; ten 6-pounder R. F. G.; fourteen 1-pounder R. F. G.; two Maxim machine guns; and four torpedo tubes. The 10-inch guns are mounted in pairs in revolving covered turrets of 10-inch nickel-steel armor. These turrets are similarly situated to the old ones, but they are smaller and have been placed nearer the midship line, so that the new and old centers do not correspond. The new guns have a maximum elevation of 35 degrees and a depression of 5 degrees. They are fitted for working by hydraulic power, but may be operated by hand if necessary. Blast shields protect the crews at the lighter pieces from the powder blast of the heavy guns.

Light bulwarks have been built along the main deck rail aft, and behind these are mounted six of the 6-inch guns, three each side. A superstructure has been built forward similar to the one aft. On its forward end, on the midship line, is placed the other 6-inch gun. Four of the 4.7-inch R. F. G. are placed on this superstructure in broadside abaft the 6-inch gun. The other 4.7-inch gun is on the extreme after end of the after superstructure.

The ammunition for the 10-inch, 6-inch, and 4.7-inch guns is stowed in magazines directly under the respective batteries below the protective deck and is supplied through large armored loading tubes. The machinery and supporting bases of the new turrets occupying so much less space in the redoubt, room has been made which is put to other uses. The engine-room hatches have been made larger; and the torpedo-tubes, which were formerly forward, have been placed in the redoubt where, being behind thick armor, they are most efficiently protected. The tubes are of the latest 18-inch pattern.

The forward smoke pipe has been removed from its former position and placed in the center line. The mast has been reduced in size at its base and the conning tower altered, being made lighter and smaller than the old one to allow the turret guns to revolve past it. As there is no room in the mast for the various connections of the tubes for the transmission of orders from the bridge to the different compartments below, a suitable armored casing has been provided for the purpose of protecting them, and also a small conning tower in front of the forward smoke pipe in which all the apparatus for the transmission of orders is collected as well as the steering wheel, thus forming a well-situated and protected station of command. The heavy davits on the side, fitted for the larger boats, have been replaced by a light derrick.

The difference in the weight of the new and old armaments is about 990 tons; the other modifications introduced, additive and subtractive, bring the gain down to 820 tons. The effect of this reduction is to reduce the displacement to 11,445 tons; draught forward, 26 feet; draught aft, 27.5 feet; mean, 26.75, a reduction of 1.625 feet.

The turrets and guns removed from the *Dandolo* and *Duilio* are to be used in coast-defense works. The cost of all the alterations of the *Dandolo*, including new boilers and repair of machinery, is estimated at $926,400. The *Duilio* will be similarly refitted.

GOITO.

(Page 204, No. V; 264, No. VI.)

This torpedo vessel of 840 tons, launched in 1887, was fitted with three screws. After careful trials it has been decided that the third screw is of no value economically or propulsively in so small a vessel and it (the middle one) is to be removed. The six boilers will all be retained. Judging from the results of the trials, it is expected that the new arrangement will give slightly greater speed than the old and that it will be more economical.

VESSELS LOST, SOLD, OR STRUCK FROM THE LIST.

To be sold: Old wooden battleships *Venezia*, *Roma*, *Maria Adelaide;* transports *Washington*, *Citta di Genova*, and *Citta di Napoli;* small cruiser *Cariddi;* gun vessels *M. A. Colonna* and *Agostino Barbarigo;* store ship *Saati.*

To be struck from list and employed for local defense: The old battleships *Palestro*, *Principe Amadeo*, *Ancona*, and *Castelfidardo.*

The old battleship *San Martino* is to be transformed into a torpedo-school ship.

TORPEDO BOATS.

Plans are being made of a large first-class torpedo boat (200 to 300 tons), which is to attain a speed of 28 knots. If it proves successful, several more will be built in quick succession. These, together with several new type torpedo boats of 125 tons displacement, comprise the principal part of the contemplated new construction for the year. Both classes mentioned above are to be fitted with water-tubulous boilers, arranged for using liquid fuel only, on the system devised by Naval Constructor Vittorio Cuniberti, Italian navy. Aluminum and its alloys will replace bronze, iron, or steel wherever they can be used advantageously.

DELFINO.

This submarine torpedo boat has been completed and placed in reserve at Spezia, in command of a lieutenant. The length of the boat is 49.2 feet; beam, 11.48 feet. The complement is 1 officer and 7 men. She is designed to make a speed of 10 knots when wholly submerged. Her official trials are believed to have been completed, but no data are yet published.

JAPAN.

No regular budget appears to have been prepared for the current year, owing to the war. The expenses of the navy have been paid out of the general war loans. It is the intention of the Japanese Government to further strengthen the navy very materially From the general tone of the Japanese press it seems likely that the additions will be chiefly battle ships, coast-defense vessels, and armored cruisers.

VESSELS PURCHASED.

IDZUMI.

The Japanese Government, through the assistance of Ecuadorian Government officials, has purchased from Chile the protected cruiser *Esmeralda.* She arrived in Japan in February, 1895, too late to take part in any of the naval engagements of the war. On her steam trials, which took place prior to purchase by Japan, the average speed maintained was about 16 knots.

The *Esmeralda*, or "*Idzumi*," as she is now called, was the prototype of the *Naniwa*, or *Charleston*, and differs very little from them except in size. The principal characteristics are as follows:

Armament.—Two 10-inch, 27-ton guns, one forward, one aft, on the midship fore-and-aft line; six 6-inch, 4-ton guns on sponsons, three each side in a central, uncovered superstructure; two 6-pounder R. F. G.; four 3-pounder R. F. G.; two machine guns; three torpedo tubes.

Protection.—Complete protective deck, 1.5 inches thick; gun shields.

Motive power.—Horizontal compound engines of 6,500 I. H. P.; speed on original acceptance, forced-draft trial, 18.3 knots.

Dimensions.—Length, 270 feet; beam, 42 feet; draught, 19 feet; displacement, 2,920 tons.

VESSELS CAPTURED.

The following table gives a list of Chinese vessels captured at Weihaiwei and elsewhere. Their new names are simply the Japanese pronunciations of the Chinese characters expressing their names in Chinese. The significations of the names remain unchanged.

Japanese name.	Chinese name.	Type.	Displacement.	I. H. P.	Speed.	Date of launch.
Taken at Weihaiwei.			*Tons.*		*Knots.*	
Chin yen	Chen yuen	Battleship	7,430	6,000	14.5	1881
Sai yen	Tsi yuen (Chi yuen)	Coast-defense vessel.	2,355	2,800	15	1883
Hei yen	Ping yuen	do	2,600	2,400	10.5	1890
Kohei	Kuang ping	Cruiser	1,030	2,400	16.5	1891
Chin nan	Chen nan	Gun vessel	440	350	8	1879
Chin hoku	Chen pei	do	440	350	8	1879
Chin sei	Chen si	do	440	350	8	1879
Chin to	Chen tung	do	440	350	8	1879
Chin chu	Chen chung	do	440	350	8	1881
Chin pen	Chen pien	do	440	350	8	1881
Taken at Asan.						
Soko	Tsao kiang	Dispatch vessel	600	....	....	....
Taken at Nuchuang.						
(?)	Mei yuen	Gun vessel	558	400	8	1869

The first four of these vessels are being thoroughly repaired, and will be regularly commissioned in the Japanese navy. Nearly all the others will probably be added to the fleet also.

VESSELS LAUNCHED.

SUMA.

(Page 64, No. XIII.)

This protected cruiser of 2,700 tons was launched at the Yokosuka navy-yard March 9, 1895. The name of the sister ship building at the same yard is the *Akashi.*

TORPEDO BOATS.

During the recent war with China the Japanese lost two torpedo boats, both at Weihaiwei. *No. 9*, after successfully torpedoing the *Ting Yuen*, was disabled, while endeavoring to escape, by a 3-pounder shell, which passed through her boiler. An attempt was made to tow her, but it was found impracticable. She was abandoned, but was recovered after the fall of Weihaiwei. *No. 22* ran on a shoal on her way out of the harbor after the attack on the Chinese fleet. After being abandoned she was destroyed by the Chinese.

Recent reports state that torpedo boat *No. 16* was lost off the Pescadores Islands, May 12, 1895. Out of a crew of fourteen only one was saved.

LIBERIA.

ROCKTOWN.

A small gunboat called the *Rocktown* has been built in England for the Liberian Government. The armament consists of four light guns.

NETHERLANDS.

The estimates for the navy for 1895 amount to 15,413,487.24 florins ($6,196,221.87), an increase of $83,474.66 over that of last year. The amount devoted to construction and repairs is $2,485,425.30, which is $50,901 less than the amount appropriated for that purpose last year. The sum of $788,322 is allotted for continuing work on the *Kortenaer*, *Evertsen*, and *Piet Hein*, and $583,141.20 is allotted as a first charge for the construction of three protected cruisers. In his argument for the construction of the new vessels the minister of marine discusses the proper duties of vessels of the *Piet Hein* (*see* Vessels Launched) type. Up to the present the same ships have been employed at different times on home and colonial service. He now proposes to change this practice. The protection of the Netherlands must be effected by a combination of the naval and land forces acting in concert. As the coast is full of shoals and outlying dangers it would not be safe for hostile vessels to operate close inshore, especially after the buoys and other navigating marks had been removed. It would then be easy to protect the few deep water channels. For this purpose good armor protection and a powerful armament are more necessary than a large coal supply or high speed, while for foreign service vessels of high speed and large coal capacity are demanded. For these reasons the minister has decided to attach the *Piet Hein* class to the home defense. As soon as these three vessels are ready for service the coast-defense vessels *Buffel* and *Guinea*, one of the old monitors, and nine gunboats, paid off last year, are to be struck from the list of effective vessels. Although it is necessary to replace these obsolete home-defense vessels by others of a new type as fast as possible, yet in view of the approaching additions to this fleet and the number of torpedo boats available it is thought more important to provide for replacing the older cruising ships.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

HOLLAND, ZEELAND, AND FRIESLAND.

These protected cruisers, proposed in this year's estimates, are to be taken in hand during the present year. Two are to be built by contract; the *Zeeland* by the Koninklijke Maatschappij de Schelde, at Vlissingen (Flushing), and the *Friesland* by the Nederlandsche Stoomboot Maatschappij, at Fijenoord. The contract price for each is $824,000, and they are to be completed in thirty months. The *Holland* is to be built at the State Wharf (Government yard), Amsterdam.

The following are their principal characteristics:

Armament.—Two 15-centimeter (5.9-inch) guns, one forward, one aft; six 12-centimeter (4.7-inch) R. F. G.; four 75-millimeter (2.95-inch) R. F. G.; eight 1-pounders; four revolving cannon. Four torpedo tubes are to be fitted, one in bow, one in stern, one each side.

Protection.—Protective deck, cellular subdivision, nickel-steel shields over 15 and 12 centimeter guns, and steel shields over the smaller pieces.

Motive power.—Twin-screw engines, designed to maintain a speed of 20 knots for 5 hours. Coal supply, 400 tons at load draught; 800 tons total capacity. The steaming radius at 10 knots, with 400 tons of coal, is estimated at 3,200 nautical miles.

Dimensions.—Length between perpendiculars, 294.45 feet; length on load water line, 305.1 feet; length over all, 306.1 feet; beam, 48.56 feet; draught, 17.7 feet with 400 tons of coal and 19 feet with 800 tons; displacement at the draught of 17.7 feet, 3,839 tons (3,900 metric tons).

VESSELS LAUNCHED.

PIET HEIN.

(Page 59, No. XIII.)

This coast-defense vessel was launched at Fijenoord in the latter part of 1894.

NORWAY.

The naval budget of 1893–94, the last in which any items for new construction occur, amounts to 2,858,000 kroner ($565,944), which was 3,000 kroner ($804) less than the estimates. The amount allotted for new construction was $134,000. The vessels proposed were a gun vessel and the torpedo boats *Varg* and *Raket* (*see* p. 66, No. XIII). Of these the *Varg* and *Raket* have been completed. Part of the cost of the gun vessel was to be borne by the Government, but the greater portion came from a subscription raised by the Ladies' Club of Christiania. The designed displacement of the vessel is 380 tons. Tenders for her construction have been invited in England, but so far as reported no contract has been made.

PORTUGAL.

The Portuguese Government wishes to establish a navy-yard, with an adequate building plant, at Lisbon. For this purpose it offers an annual subsidy of about $550,000 for twenty years to a company which will establish a building and repairing yard on Portuguese territory, under the following conditions: To do all of the building and repair work of the Government and of the colonies of Cape Verde, Azores, and Angola, for which the material and fuel will be supplied by the Government, and at the end of twenty years to turn over the plant to the Government. No offers have been received, and it does not seem probable that any will be made.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

The new program of construction, according to the proposals of the minister of marine, is as follows:

Two small armored vessels of 2,500 tons and 14 knots speed, of the type of the Argentine coast-defense vessel *Independencia* (*see* p. 66, No. X; 145, No. XII).

Two protected cruisers of about 3,500 tons, I. H. P. 14,000, speed 22 knots, of the type of the Argentine protected cruiser *Nueve de Julio* (*see* p. 59, No. XI; 145, No. XII; 3, No. XIII). To be commenced in 1897 and completed in 1900.

Two protected cruisers of about 2,600 tons, speed 20 knots, of the type of the British protected cruiser *Mildura* (*see* p. 304, No. VII; 335, No. VIII; 16, No. IX; 24, No. X). To be commenced in 1897 and completed in 1899.

Four gun vessels of 1,000 to 1,300 tons, speed 13 knots, of the type of the Portuguese gun vessel *Affonso de Albuquerque* (composite; 1,100 tons; battery, two 6-inch, two 5.5-inch guns; speed, 12 knots). To be commenced and completed between 1895 and 1900.

One transport of 4,000 to 4,600 tons and 16 knots speed.

Four small gunboats of the type of the *Cacongo* (p. 273, No. VI).

One school ship.

Two light-draught stern-wheel gunboats.

Thirty-eight torpedo boats (*see* Torpedo Boats).

It is very improbable that the whole program will be carried out, as it is not believed that the Government will be able to raise sufficient money for the purpose.

ADAMASTOR.

About a year ago proposals were invited for the construction of a cruiser of about 2,000 tons to have a speed of at least 16 knots. The contract was given to Messrs. Orlando Bros., of Livorno (Leghorn), and the vessel has been named the *Adamastor.* Her principal characteristics are:

Armament.—Two 15-centimeter (5.9-inch) guns, one forward, one aft; four 105-millimeter (4.13-inch) R. F. G.; two 3-pounder R. F. G.; four Nordenfeldt machine guns; one torpedo tube in the bow; two training torpedo tubes, one each side.

Motive power.—Twin-screw, vertical, triple-expansion engines, designed to develop 3,000 I. H. P. with natural draft and 4,000 I. H. P. with forced draft; corresponding estimated speeds, 16 and 17.3 knots. The steaming radius, at 10 knots, is estimated at 7,200 nautical miles.

Dimensions.—Length, 242.7 feet; beam, 35.11 feet; draught 14.04 feet; displacement, 1,800 tons.

DIEGO CAO AND PEDRO ANNAYA.

Two small gunboats of the *Zagaia* type, building at the yard of Messrs. H. Parry & Son, Ginjal. Cost of the two, $36,288.

LACERDA, SERPA PINTO, CAPELLO, AND IVENS.

Light-draught, stern-wheel gunboats, built by Messrs. Yarrow & Co., Poplar, England, for river service in Africa. They have all been completed. The dimensions are: Length, 89 feet; beam, 18 feet; draught of the first two, 1.5 feet; of the last two, 11.6 inches. The speed is 10 knots.

TORPEDO BOATS.

The new program of construction includes the following: Three large first-class torpedo boats of the *Hornet* (*see* p. 39, No. XIII) type; twelve smaller first-class boats; twenty-three second and third class boats.

RUSSIA.

The total amount of the naval budget for 1895 is 51,145,674 paper rubles ($26,902,624.50; paper ruble at $0.526). The amount devoted to ship construction, repairs, armament, machinery, equipment, etc., is $13,279,520.14, of which $4,102,983.57 is for hulls of vessels building or proposed; $2,145,702.86 for their machinery, and $1,250,023.22 for armor. The amount devoted to new construction not previously authorized is $1,250,023.22.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

There are now building for the Russian navy the following vessels:

Name.	Type.	Displacement.	Remarks.
		Tons.	
Sisoi Velikii	Battleship	8,800	Launched; at St. Petersburg.
Poltava	do	10,960	Do.
Petropavlovsk	do	10,960	Do.
Sevastopol	do	10,960	Do.
Admiral Senyavin	Coast-defense vessel	4,126	Do.
Admiral Ushakov	do	4,126	Do.
Navarin	Battleship	9,476	Launched; at Cronstad.
Russia	Armored cruiser	12,130	Keel laid; Baltic works, St. Petersburg.
General Admiral Apraxine	Coast-defense vessel	4,126	Keel laid; New Admiralty Yard, St. Petersburg.
Sisoi Velikii No. 3	Battleship	8,800	Do.
Khrabry	Armored Gun vessel	1,492	Do.
Tri Sviatitelya	Battleship	12,480	Launched; at Sevastopol.
Rostislav	do	8,800	Keel laid; at Nikolaef.
Unnamed	Protected cruiser	3,828	Building; at Graville yard, Havre.
Verni	School ship	1,280	Keel laid; Baltic works, St. Petersburg.
Samoied	Transport	1,055	Nearly finished; Thames Iron Works, England.
Vladimir	do	....	Nearly finished; W. Denny & Bros., Dumbarton, Scotland.
Khabarovsk	do	2,700 (?)	Nearly finished; Hawthorn, Leslie & Co., Hebburn-on-Tyne, England.
Kherson	do	10,200 (?)	Do.
Grand Duke No. 1	do	2,400 (?)	Do.
Grand Duke No. 2	do	2,400 (?)	Do.
Standard	Yacht	5,200	Launched; Burmeister & Wain, Copenhagen.
Unnamed	Torpedo vessel	....	Keel laid; Crichton & Co., Abo, Finland.
Rurik	Armored cruiser	8,000	To be built on the slip left vacant by the launch of the Petropavlovsk at Galernia-Ostrovon.
Unnamed	Gun vessel	926	Proposed.
Unnamed	Transport	....	Merchant steamer to be purchased and transformed.
Unnamed	do	....	To be built in Russia.
Torpedo boats. (See Torpedo Boats.)	....	....	

RUSSIA.

The keel of this large armored cruiser was laid at the Baltic works, St. Petersburg, June 1, 1895. The principal characteristics are:

Armament.—Four 8-inch guns in sponsons forward and aft; sixteen 6-inch guns in sponsons, eight each side; six 4.7-inch R. F. G. on the upper deck; thirty-six smaller R. F. G. and machine guns. Five torpedo tubes are fitted and four third-class torpedo boats will be carried.

Protection.—Partial water-line belt extending about three-fourths the length; protective deck; gun protection.

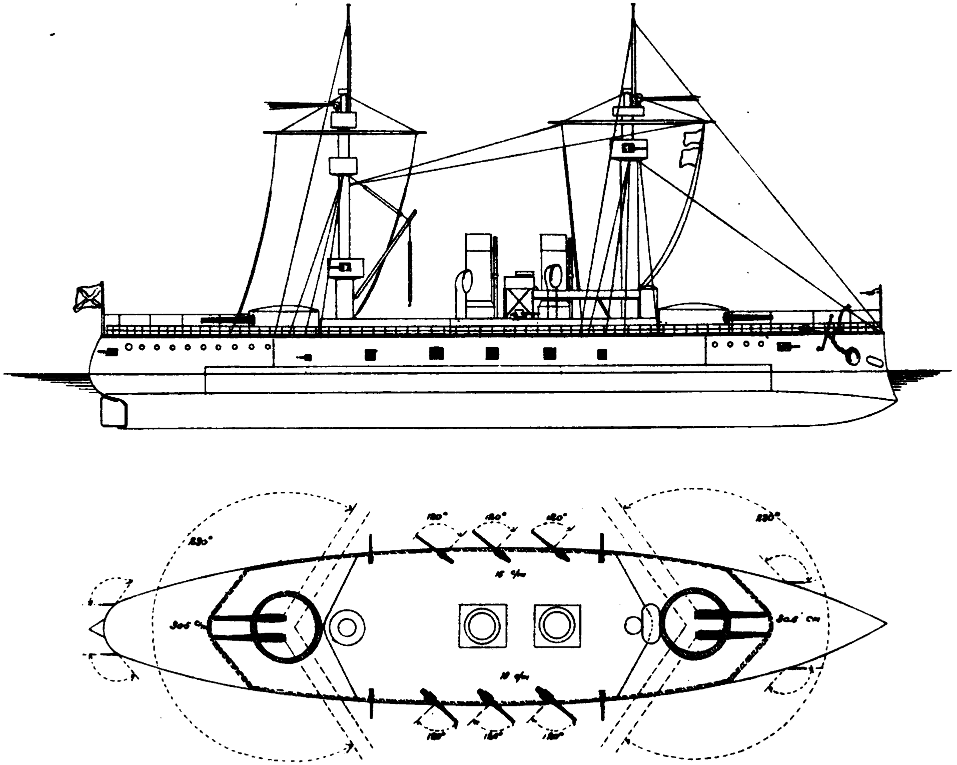

Fig. 5. RUSSIAN BATTLESHIP SISOI VELIKII.

Motive power.—Triple-screw engines of 17,000 I. H. P., estimated to give a speed of 19.5 to 20 knots; I. H. P. of each side engine, 7,250; of the middle engines, 2,500. With the middle engines alone working the estimated speed is 9 knots. Belleville boilers to supply steam for 14,500 I. H. P. and cylindrical boilers to supply steam for 2,500 I. H. P. are fitted. The boilers will have specially designed furnaces arranged for burning petroleum if desired.

Dimensions.—Length, 480 feet; beam, 68.5 feet; draught, 25 feet; displacement, 12,130 tons. The complement will consist of 35 officers and 700 men.

RURIK NO. 3.

(Page 67, No. XIII.)

The third vessel of the *Rurik* type has not yet been commenced. She will be built on the slip left vacant by the launch of the *Petropavlovsk* at the Government yard, Galernia-Ostrovon. The budget calls for an armored cruiser of about 8,000 tons. It is not likely that the resemblance to the *Rurik* or *Russia* will be very close, but she will probably have the same general arrangement of armor and armament.

SISOI VELIKII NO. 2.

The keel of this vessel was laid at the New Admiralty Yard, St. Petersburg, in the latter part of 1894, on the ways left vacant by the launch of the *Poltava.* It is reported that she will be a sister ship to the *Sisoi Velikii* (*see* fig. 5) in all respects except some minor details.

GENERAL ADMIRAL APRAXINE.

(Page 67, No. XIII.)

The keel of this vessel was laid at the New Admiralty Yard, St. Petersburg, June 1, 1895, on the slip left vacant by the launch of the *Sisoi Velikii.* She will be a sister ship in all essential respects to the *Admiral Senyavin* and *Admiral Ushakov.*

PROTECTED CRUISER.

This vessel has been ordered from the Société Nouvelle des Forges et Chantiers de la Mediterranée, and she will be laid down at the company's yard at Graville, near Havre. The principal characteristics are:

Armament.—Six 6-inch guns; ten 3-pounder R. F. G.; four torpedo tubes. Other guns between the 6-inch and 3-pounders will probably be added.

Protection.—Protective deck, 1 to 2 inches thick; gun protection.

Motive power.—Twin-screw engines of 8,500 I. H. P., with forced draft. Estimated speed, 20 knots.

Dimensions.—Length, 331.3 feet; beam, 42.66 feet; draught aft, 18.83 feet; displacement, 3,828 tons.

KHRABRY.

The keel of this armored gun vessel was laid at the New Admiralty Yard, St. Petersburg, June 1, 1895, on the slip left vacant by the launch of the *Admiral Senyavin.* The *Khrabry* will be a sister ship of the *Otvajnii* (p. 72, No. XIII) in all essential details.

VERNI.

The *Verni* is to be a training vessel of the *Voin* type. She is building by contract at the Baltic Works, St. Petersburg, where the keel was laid June 1, 1895. The contract price is $315,600. The principal characteristics are said to be as follows:

Armament.—Six 4-inch and five smaller R. F. G.

Motive power.—The steam power will be auxiliary to the sails; I. H. P. about 400.

Dimensions.—Length, 203 feet; beam, 36 feet; displacement, 1,280 tons.

GUN VESSEL.

A gun vessel of 926 tons displacement, to cost (hull and machinery) $368,000, is provided for by this year's budget.

TORPEDO VESSEL.

A small torpedo vessel is said to be under construction at the yard of Messrs. Crichton & Co., Abo, Finland.

TRANSPORT SAMOÏED AND TWO OTHERS.

The transport *Samoïed* is building at the yard of the Thames Iron Works and Shipbuilding Company, Blackwall, England. The contract price for hull and machinery is $113,880.78. The principal characteristics are:

Armament.—Two 3-pounder and two 1-pounder R. F. G.

Motive power.—Triple-expansion engines of 1,050 I. H. P.; estimated speed, 12 knots.

Dimensions.—Length, 170 feet; beam, 33 feet; mean load draught, 12 feet; displacement at this draught, 1,055 tons.

A similar vessel is to be built at St. Petersburg; estimated cost, $168,320.

The third transport is to purchased. A suitable merchant steamer already completed will be selected and such alterations in her arrangements as may be desirable will be made. Estimated cost, $210,400.

VLADIMIR, KHABAROVSK, KHERSON, GRAND DUKE NO. 1 AND GRAND DUKE NO. 2.

These vessels are intended for the Russian volunteer fleet. The first named is building at the yard of Messrs. W. Denny & Bros., Dumbarton, on the Clyde, and the others by Messrs. Hawthorn, Leslie & Co., Hebburn-on-Tyne.

Vladimir.—Twin-screw steamer; length, 419 feet; beam, 49 feet 6 inches; draught, 24 feet.

Kherson.—Twin-screw steamer of 10,200 tons displacement; length, 493 feet; beam, 54 feet; draught, 24 feet.

Khabarovsk.—Twin-screw steamer of 2,700 tons displacement; length, 265 feet; beam, 36 feet; draught, 14.5 feet. The I. H. P. of the machinery is 1,800; estimated speed, 13 knots.

Grand Duke No. 1 and Grand Duke No. 2.—The proper full names for these vessels do not seem to have been definitely settled. They are referred to in English periodicals by the names above given. They are single-screw steamers of 2,400 tons displacement. Length, 288 feet; beam, 37 feet; draught, 15 feet. The designed I. H. P. of the machinery is 2,500 and the estimated speed 14.5 knots.

LIGHT-DRAUGHT GUNBOAT.

This boat, which has a length of 150 feet, has very light draught, and is intended for service on the Amu Daria. She was built in several sections, and after being tried under steam was taken apart and shipped to her destination. The boilers are arranged to burn petroleum fuel, and the apparatus is said to have passed a severe trial test very satisfactorily.

VESSELS LAUNCHED.

POLTAVA, PETROPAVLOVSK, AND SEVASTOPOL.

These first-class battleships have all been launched; the *Poltava*, November 6, 1894; the *Petropavlovsk*, November 9, 1894, and the *Sevastopol*, June 1, 1895. They are sister ships as regards the hull, but the machinery differs slightly, though practically the same in power. One military mast and one pole signal mast are fitted. The principal characteristics are:

Armament.—Four 12-inch L/40 guns, mounted in pairs in barbette towers forward and aft; twelve 6-inch L/45 guns, eight in pairs in four small barbette towers, two each side in the waist, and four in broadside on the gun deck, between but below the small barbette towers. There are also about twenty 3-pounder and 1-pounder R. F. G. Six torpedo tubes are fitted.

Protection.—Partial armor belt extending along the water line for about three-fifths the length amidships; thickness, 16 inches over the middle body and tapering to 8 inches at the ends where it meets the diagonal bulkheads which join it to the 12-inch gun barbettes. The thickness of the forward diagonal bulkhead is 9 inches and of the after one 8 inches. Protective deck over belt and at the ends beyond the belt; thickness 2.5 to 3.5 inches. Armor on large barbette towers, 10 inches; on small barbette towers, 5 inches; hoods over all barbette guns, 3 inches. Side armor above belt, 5 inches. All the armor of 5 inches and thicker is Harvey face-hardened.

Motive power.—Twin-screw engines of 10,600 I. H. P. with natural draft and 13,500 with light air pressure; estimated maximum speed, 17.5 knots. The engines are practically the same as those in the *Royal Sovereign* class in the British navy (*see* p. 21, No. XIII). There are sixteen single-ended main boilers and two auxiliary boilers. Normal coal supply, 900 tons; total coal capacity, 1,300 tons.

Dimensions.—Length on water line, 375 feet; length between perpendiculars, 356 feet; breadth at water line, 70 feet; mean draught, 26 feet; displacement, 10,960 tons.

ADMIRAL SENYAVIN.

(Page 160, No. XII; 68, No. XIII.)

This coast-defense vessel of 4,126 tons was launched at the New Admiralty Yard, St. Petersburg, August 22, 1894.

STANDARD.

(Page 67, No. XIII.)

This vessel is of the customary yacht model with clipper bow and overhanging stern. There are three pole masts with fore-and-aft rig; two smoke pipes; light bulwarks around upper deck; long after-deck house, containing a drawing room and a dining saloon capable of seating 60 persons. On the main deck are the cabins and staterooms—aft for the imperial family and suite, farther forward for the officers of the ship. The keel was laid in August, 1893, at the works of Messrs. Burmeister & Wain, Copenhagen, and she was launched March 10, 1895. The original design called for a steel hull, with wood and copper sheathing, and a displacement of 5,557 tons. The contract was changed, however. The hull is of steel without sheathing, and the dimensions are as given below.

Motive power.—Consists of two twin-screw triple-expansion engines of 10,600 I. H. P. with natural draft and 15,000 with forced draft. The maximum estimated speed is expected to be about 21 knots. Belleville boilers are fitted.

Dimensions.—Length between perpendiculars, 370 feet; beam, 50.5 feet; mean draught, 18.5 feet; displacement, 5,200 tons.

STEAM TRIALS.

RURIK.

(Page 38, No. IX; 161, No. XII.)

The steam trials of the first-class armored cruiser *Rurik*, 10,923 tons (*see* fig. 6), took place on October 15 and 23, 1894, at a mean draught of 24.12 feet and a displacement of 9,407 tons. The results were:

	Runs.			
	First.	Second.	Third.	Fourth.
Revolutions	80.5	82	82	82
Speed, knots	18.04	18.97	18.74	19.17

OTVAJNII.

(Page 44, No. X; 46, No. XI; 72, No. XIII.)

This armored gun vessel of 1,492 tons has completed her steam trials with the following results: Steam pressure, 150 pounds; revolutions, 164; I. H. P., 2,589; speed, 15.5 knots.

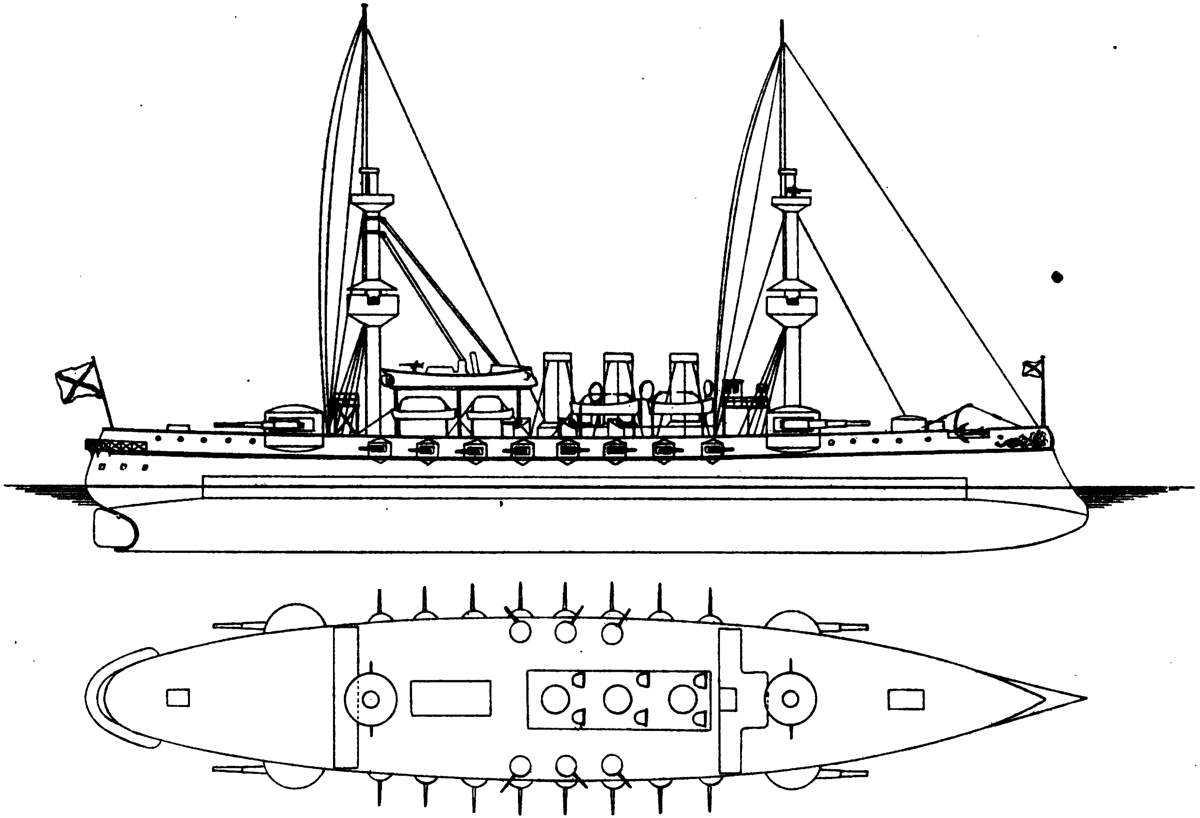

Fig. 6. RUSSIAN ARMORED CRUISER RURIK.

GEBIETE DES SEEWESENS.

VESSELS LOST, SOLD, OR STRUCK FROM THE LIST.

The names of the dispatch vessels *Rossilnii* and *Batiuska* have been struck from the list. The Amu Daria flotilla, consisting of the *Czar*, *Czariza*, *Petersburg*, and *Moskwa*, have been transferred to the war department and stricken from the list of the fleet. The old imperial yacht *Derzava* has been condemned as unfit for further service as a yacht. She has been stripped of her fittings, and will be stationed at Cronstadt for harbor service.

TORPEDO BOATS.

The budget for 1895 provides for the following: One first-class boat of the *Havock* (*see* p. 39, No. XIII) type (*Sokol*); two first-class boats of the *Anakria* type (*see* p. 39, No. IX), displacement, 85 tons, building at the Government yard at Ijora; thirteen of the *Pernov* type (*see* p. 161, No. XII), 118 tons, three to be built at Ijora and ten at the Nevsky works, St. Petersburg.

SOKOL.

This large first-class boat of the *Havock* type (p. 39, No. XIII) is building at the yard of Messrs. Yarrow & Co., of Poplar, England.

Armament.—Two training torpedo tubes on deck; one 7.5-centimeter (2.95-inch) R. F. G. on the forward conning tower; two 3-pounders on each side.

Motive power.—The machinery consists of twin-screw triple-expansion engines of 4,500 I. H. P.; eight Yarrow tubulous boilers; contract speed, 29 knots.

Dimensions.—Length, 190 feet; beam, 18.6 feet; draught, 7 feet; displacement, 240 tons.

SANTO DOMINGO.

INDEPENDENCIA.

This small vessel is intended for a Government yacht and dispatch boat. She was built by Messrs. Napier, Shanks & Bell, of Glasgow, and launched September 3, 1894. The hull is of steel.

Armament.—One 6-pounder R. F. G. on the forecastle; four 3-pounders on the broadside; two 37-millimeter H. R. C. aft.

SPAIN.

The total amount of the estimates for 1895 is 23.470,114 pesetas ($4,529,732).

VESSELS PROPOSED, AUTHORIZED, AND BUILDING.

SIX SMALL GUNBOATS.

Six very small gunboats, intended for service in Cuban waters, are to be built in Spain. Their principal characteristics are:

Armament.—One 42-millimeter (1.65-inch) 2.5-pounder Maxim-Nordenfeldt R. F. G.; one 37-millimeter R. F. G.

Motive power.—Triple-expansion engine; contract speed with natural draft, 10 knots during an eight-hour run; with forced draft 12 knots. Steaming distance at 6 knots, 700 nautical miles.

Dimensions.—Length, 68.9 feet; beam, 11.8 feet; draught, 4.9 feet; displacement, 40 tons.

VESSELS LAUNCHED.

EMPERADOR CARLOS V.

(Page 50, No. IX.)

This first-class armored cruiser was launched at the yard of Messrs. Vea-Murguia Bros., Cadiz, March 12, 1895. The keel was laid March 4, 1892. The vessel was to be completed in forty months from the date of contract, but this period is likely to be exceeded by two years. The hull is of steel, without sheathing. Two light military masts, each carrying one top, are fitted. The principal characteristics are:

Armament.—Two 28-centimeter (11.02-inch) Gonzalez-Hontoria guns, mounted singly in barbette towers forward and aft; eight 14-centimeter (5.5-inch) Gonzalez-Hontoria guns, mounted in sponsons, four on the main deck and four on the gun deck; four 10-centimeter (3.94-inch) Gonzalez-Hontoria R. F. G., two on main deck in the waist between the 14-centimeter guns and two in recessed ports on the gun deck forward; four 6-pounder and four 3-pounder R. F. G.; two machine guns. Six torpedo tubes are fitted, one forward, one aft, and one on each bow and quarter.

Protection.—Complete protective deck, made up of three thicknesses of plating; maximum thickness on slopes over the middle body, 6.1 inches. Side armor over outside plating 167.3 feet long, 5.75 feet wide, and 1.97 inches thick, with bulkheads at ends of the same thickness, made up of two thicknesses of 0.984-inch plates, one of Siemens-Martin and one of chrome steel. Barbette towers, 20.3 feet in diameter; armor, 9.8 inches thick; gun shields over barbette guns, 3.94 inches; armor of loading tubes for 28-centimeter guns, 7.87 inches thick.

Motive power.—Twin-screw, four-cylinder, triple-expansion engines, designed to develop 15,000 I. H. P. with natural draft and 18,500 with forced draft; corresponding estimated speeds, 19 and 20 knots. There are twelve single-ended cylindrical boilers, 16.3 feet in diameter and 9.85 feet long, designed to carry a steam pressure of 147 pounds. The coal supply is 1,771 tons; estimated steaming distance with this amount of coal, about 12,000 nautical miles at 10 knots.

Dimensions.—Length between perpendiculars, 380 feet; length over all, 404.7 feet; beam, 67 feet; mean draught, 24.5 feet; draught aft, 25.5 feet; displacement, 9,089 tons (9,235 metric tons).

QUIROS.

(*See* Steam Trials.)

This small single-screw gun vessel was launched from the yard of the Hongkong and Whampoa Dock Company Hongkong, January 24, 1895. The principal characteristics are:

Armament.—Two 6-pounder Hotchkiss R. F. G., one forward, one aft; two 1-inch, 5-barrel Nordenfeldt machine guns, one each side in sponsons.

Motive power.—Single-screw triple-expansion engines of 500 I. H. P., designed to give a speed of 12 knots. Steam at 170 pounds pressure is supplied by two single-ended cylindrical boilers. Coal capacity, 75 tons. Steaming radius (estimated), 3,775 nautical miles.

Dimensions.—Length over all, 145.25 feet; beam, 22.83 feet; depth, 11 feet; displacement, 347 tons.

GENERAL ALAVA.

This transport, built for service in the Philippine Islands, was launched at the yard of A. McMillan & Son, Limited, Dumbarton, Scotland, May 8, 1895. The hull is of steel without sheathing. Provision has been made for carrying a suitable armament when the vessel is on her station, and magazine accommodation is provided in the hold. The machinery is single-screw, triple-expansion. The dimensions are: Length, 212 feet; beam, 30 feet; draught, 18.75 feet.

STEAM TRIALS.

VISCAYA.

(Page 318, No. VII; 355, No. VIII; 42, No. IX; 51, No. X.)

This armored cruiser, a sister ship in all respects to the *Infanta Maria Teresa*, fully described on pages 74 to 76 in General Information Series No. XIII, has completed her trials. The results with forced draft were: I. H. P., 13,000; speed, 20.3 knots. The results with natural draft were: I. H. P., 9,500; speed, 18 knots.

QUIROS.

(*See* Vessels Launched.)

This gun vessel recently completed her steam trials. The reported results were: I. H. P., 480; speed, 12 knots.

VESSELS LOST, SOLD, OR STRUCK FROM THE LIST.

REINA REGENTE.

The protected cruiser *Reina Regente*, 4,750 tons (*see* p. 271, No. VI; 320, No. VII), foundered at sea off the Spanish coast, March 10, 1895. As all hands were lost the cause of the disaster is not known.

SWEDEN.

In the Swedish naval estimates for 1895 authority is asked for continuing the construction program already laid down. (*See* p. 77, No. XIII.)

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

ODEN.

(Page 77, No. XIII.)

The construction of the coast-defense vessel described in No. XIII has been commenced. She is to be named the *Oden*. The plate facing page 77, No. XIII, should have been entitled "New Svea type" instead of merely "Svea." It represents the *Oden* and the two projected sister ships.

TORPEDO BOATS.

The first-class boats *Gondul* and *Gudur* have had their steam trials. The speeds attained were 19.2 and 19.94 knots, respectively.

TURKEY.

The allotment for naval purposes for 1895 is said to be 650,000 pounds Turkish money ($2,860,000), a decrease of 50,000 pounds ($220,000) from that of 1894. There is a programme of construction laid down, but the money for carrying it out is lacking.

VESSELS PROPOSED, AUTHORIZED, OR BUILDING.

On the stocks in Turkish Government yards are:

Armored cruiser *Abdul Kader*. The work on this vessel, laid down three years ago, is proceeding so slowly that only nine frames have been erected. Protected cruisers *Hudavendikiar* and *Selimie*, sister ships, steel, 4,050 tons, building, not yet launched. Cruisers *Feiz-i-bahri* and *Schadié* (*see* p. 61, No. XI), sister ships, steel, 1,815 tons, building, not yet launched.

The construction of six additional gun vessels for coast guard and revenue service is projected; also the transformation of the steamer *Candia* into a cruiser. A mining boat is said to have been ordered from the Société Nouvelle des Forges et Chantiers de la Méditerranée, but the report lacks confirmation.

VESSELS LAUNCHED.

PELENG-I-DERYA AND NIMET.

The torpedo vessel *Peleng-i-Derya*, 850 tons, has been delivered to the Turkish Government by the builders, the Germania Schiff und Machinenbau Actien Geselleschaft, of Kiel, Germany. This is the vessel described on page 78, No. XIII. The *Nimet*, a sister ship, is building at the same yard.

KILID BAHR AND ZOHAF.

These are small gun vessels of 643 tons displacement, and were both launched during 1894.

Armament.—Four 4.7-inch Krupp R. F. G.; several smaller R. F. G. and machine guns.

Motive power.—Single-screw engines, designed to give a speed of about 12 knots.

Dimensions.—Length, 190.2 feet; beam, 24 feet; mean draught, 11.5 feet; displacement, 643 tons.

The *Kilid Bahr* was at first called the "*Sedul Bahr.*"

SHEFKET NUMA, SEYAD-I-DERYA, RECHBER AND ACHBER.

These very small gunboats were launched during the past year. The *Shefket Numa* is of 200 tons displacement, the *Seyad-i-Derya* of 104 tons, and the other two of 70 tons each.

TORPEDO BOATS.

TAIJAR AND BERK-EFSCHAN.

These first-class torpedo boats, modeled after the German division boats, have also been delivered by the Germania Company, of Kiel. The dimensions are: Length, 187 feet; beam, 21 feet; draught, 12 feet; displacement, about 270 tons.

II.

NOTES ON ORDNANCE AND ARMOR.

By Lieut. P. V. Lansdale, United States Navy,
Staff Intelligence Officer.

GUNS AND MOUNTS.

As pointed out on page 165, General Information Series No. XII, and page 79, No. XIII, the tendency in the development of gun construction is undoubtedly in the direction of guns of moderate dimensions, which may be man-handled but developing enormous power, and in improvements in breech mechanism tending to increase rapidity of fire. The full utilization of the energy produced by recoil is probably yet in its infancy. Most of the features which characterize a rapid-fire gun are being extended to heavy calibers as far as practicable, though these are not rapid-fire guns in the strict sense of the term. The largest caliber so far fitted with a metallic cartridge case is the French 6.48-inch gun, while the heaviest caliber with which fixed ammunition is used is 5.51 inches.

In these notes guns described under the different countries are given the designation "R. F." if so called by the authorities quoted, but the term is only applied by this office to guns using fixed ammunition.

The recent naval battle in Asiatic waters gives an illustration of the value of modern artillery fire. The Japanese fleet, with fifty-nine 4.7-inch and eight 6-inch R. F. G., were opposed to a Chinese fleet with practically none. The Japanese guns were purchased in England, and at the proof trials a 4.7-inch is said to have been fired seven times in 25 seconds. Three of the Japanese ships each possessed one long gun of great power. This gun is a 32-centimeter (12.6-inch), L/40, built by the Forges et Chantiers de la Méditerranée Company in 1890. Excepting the British 111-ton and the Italian 105-ton it was the most powerful gun afloat. The perforations through iron, calculated by the Krupp formula, for these three guns are 38.3, 37.4, and 35.8 inches, from which it may be seen that the Japanese gun actually stands first. Probably, as fired in service, these three types might be regarded as equals; though in energy the larger ones have an advantage, due to their heavier projectiles, as the following table will show:

Nation.	Caliber of gun.	Weight of projectile.	Weight of gun.	Muzzle energy.
		Pounds.	*Tons.*	* *Foot-tons.*
British	16.25	1,800	111	54,320
Italian	17	2,000	105	55,030
Japanese	12.6	990	65	39,770

This gun was mounted in barbette. For a detailed description of the carriage *see* page 155, No. X, and plate. The mount worked well as long as the hydraulic gear remained intact. It is reported that on board of the Japanese flagship, which carried one of these guns, a fragment of a shell cut one of the pipes belonging to the system and the gun was thereby put out of action after the third discharge. During the prevalence of very cold weather much care had to be exercised to prevent the liquid in the system from freezing. Besides the use of glycerine in the water, various devices were resorted to to keep the inside of the turret and the hydraulic rammer warm.

Regarding the performance of these guns, they did not play the prominent part which one might expect. As for the other guns carried by the Japanese ships, the 4.7-inch R. F. G. fired projectiles weighing 45 pounds, those of the *Yoshino*, protected cruiser, being provided with smokeless powder. Her 6-inch R. F. G. weighed 6 tons, and with a charge of 15 pounds of cordite the 100-pound projectile had a penetrating power of 8 inches in iron at 2,700 yards.

The Chinese vessels were provided principally with Krupp guns, and these were not of a recent design. The largest were mounted in turrets on board of the battle ships *Chen yuen* and *Ting yuen*. They were 30.5 centimeters (12 inches) in caliber, and were built in 1878. At that time they were a marked advance in the construction of heavy artillery, and were the most formidable guns actually in service. As was the custom at that date, we may compare them with the Woolwich M. L. guns of nearly the same caliber:

Factory.	Caliber.	Tons.	Length, in calibers.	Muzzle velocity.	Energy.	Perforation in wrought iron.
	Inches.			*Feet.*		*Inches.*
Woolwich	12.5	38	16	1,575	14,105	19.5
Krupp	12.0	35.4	18.9	1,712	14,740	20.5

The two battle ships alluded to carried eight of these guns between them, which at the battle off the Yalu were fired about 197 times, or at the rate of from 5 to 6 rounds per hour. The four 5.9-inch guns which they carried were fired at the rate of from 12 to 13 rounds per hour. A reported failure of Chinese shells to explode is explained by the fact that but very few common shells were fired, owing to the deficient supply of the latter. The other guns of the main battery were Krupp

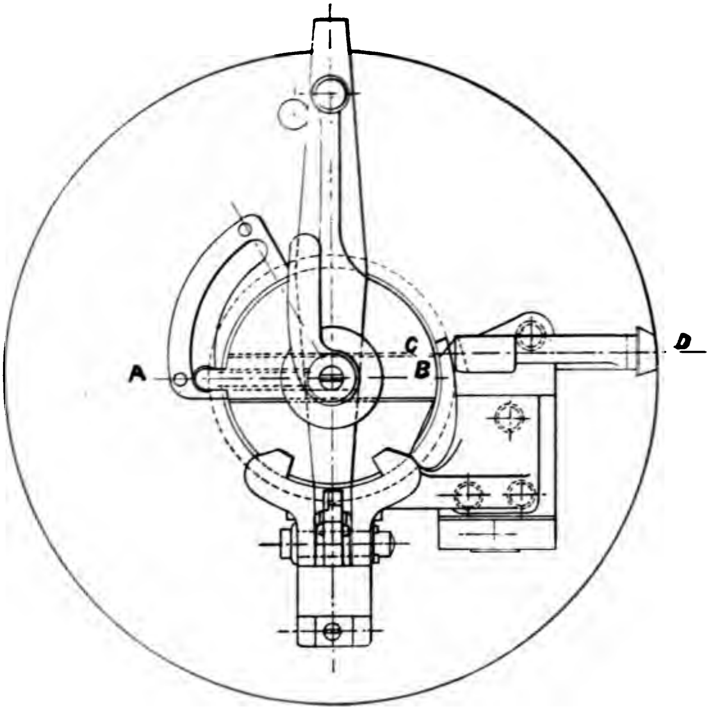

Fig. 1.

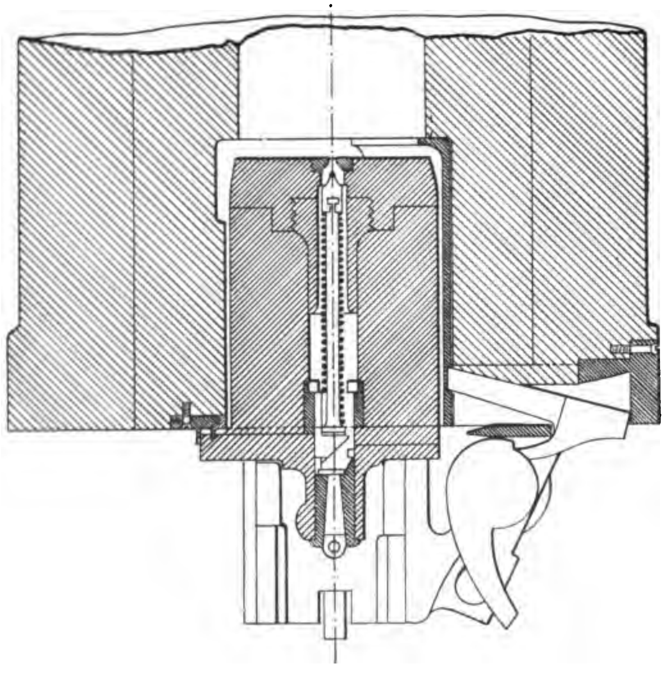

Fig. 2.—Section through A B C D.

BREECH MECHANISM OF THE 100, 138.6, AND 164.7. MILLIMETER CONVERTED R. F. GUN.

type, except four 10-inch Armstrong. The only explosions reported were on board of the *Kuang ping*, a Chinese cruiser. Two Hotchkiss 47-millimeter (1.85-inch) guns burst, most of the fragments going overboard. It is a significant fact that in the magazine of this ship soon afterwards were found 47-millimeter cartridge cases containing a powder resembling cordite. The guns bore the name of an English manufacturer.

A foreigner on board one of the Chinese ships at the battle of the Yalu is quoted as saying:

> The Japanese knew how to profit by their superior armament. The R. F. G. gave them an immense advantage, enabling them to throw an all-around rain of shots, thus setting on fire the Chinese ships and riddling everything which was not sheltered from their fire. Thus it was that the Chinese ships began to burn soon after the action opened. The wooden fittings were set on fire, and the iron bulkheads exposed to this rain of projectiles were rapidly destroyed. The smoke pipes were riddled through and through, and the military tops transformed into death traps. No other result was possible. Not a single heavy R. F. G. was mounted in the Chinese fleet, and their ships had practically no secondary battery at all.

The effect of the very heavy gun fire merits a close examination. To this cause must be ascribed the loss of the armored cruiser *King yuen* and the protected cruiser *Chih yuen*, besides the tremendous damage done to the Japanese flagship. On the other hand, the two Chinese battle ships, *Chen yuen* and *Ting yuen*, stood the hammering for more than five hours without their vitals being affected. Their armor was old-type compound of from 8 to 14 inches in thickness, and very inferior to the surface-hardened article of the present day. The deepest scar in the belt of either one of them was 3.1 inches. The range at which much of the firing was done was upward of 2,000, sometimes over 3,000 yards, so that the lack of marks made by heavy projectiles must be attributed to the difficulty of hitting the exceedingly small targets presented at such distances, rather than to insufficient muzzle velocity.

FRANCE.

The naval appropriation for 1895 as voted included the following items under ordnance: Manufacture and repair of ordnance, 7,000,000 francs ($1,351,000); extraordinary, for new ships, 1,000,000 francs ($193,000); ammunition, 13,900,000 francs ($2,682,700); maintenance of arms, etc., 500,000 francs ($96,500); torpedoes, 300,000 francs ($57,900).

In the navy estimates for 1896, presented to the Chamber of Deputies May 14, 1895, under ordnance appear the following items: Manufacture and repair of ordnance, 7,750,000 francs ($1,495,759); ammunition, 12,900,000 francs ($2,489,700); maintenance of arms, etc., 500,000 francs ($96,500); torpedoes, etc., 250,000 francs ($48,250).

The French continue to convert their guns of calibers up to and including the 164.7-millimeter (6.48-inch) to rapid-fire by making several modifications. (*See* figs. 1 and 2, and p. 94, No. XI.) The principal alterations made are as follows: The plug handle is replaced by a system of levers which facilitates the operation of turning and withdrawing the plug. The latter is fitted with an extractor, and with a lock which extends through the entire length of the plug (*see* fig. 3). It is also provided with an automatic safety latch. A shorter mushroom, which is rigidly attached to the plug, takes the place of the old one. Through the mushroom head opposite the primer-cap are two small vents designed to relieve the pressure of the gas in case of the rupture of the primer cap. In cases where the breech mechanisms are fitted by the Forges et Chantiers de la Méditerranée Company they are of the Canet pattern.

The calibers now in use in the French naval service are given in the following table, taken from the *Manuel du Marin-Canonnier:*

Models.	Caliber.	
	Mm.	*Inches.*
1881	65	2.57
1881	90	3.54
1875, 1875 M, 1881, 1884	100	3.94
1870, 1870 M, 1881, 1881 M, 1884	138.6	5.45
1870, 1881, 1884	164.7	6.48
1870, 1887, 1892	194	7.64
1870, 1881, 1884, 1887, 1892	240	9.45
1870, 1870 M, 1875, 1875 M, 1881, 1884, 1887, 1892	274.4	10.80
1887, 1892	305	12
1870, 1870 M	320	12.60
1875, 1881, 1884, 1887	340	13.39
1875-79	370	14.57
1875	420	16.54

The following is a list of R. F. (*tire rapide*) guns in use in the French navy:

Gun.	Caliber.		Model.	Muzzle velocity.
	Mm.	*Inches.*		*Feet.*
Rapid-fire	65	2.57	1888 R. F.	2,346
Do	65	2.57	1891 R. F.	2,346
Do	100	3.94	1881 R. F.	1,837
Do	100	3.94	1889 R. F.	2,494
Breech-loading	100	3.94	1891	2,494
Do	100	3.94	1892 (long).	2,494
Rapid-fire	138.6	5.45	1881	2,100
Do	138.6	5.45	1881 M.	2,100
Do	138.6	5.45	1884	2,100
Breech-loading	138.6	5.45	1887	2,526
Do	138.6	5.45	1887 (short plug).	2,296
Do	138.6	5.45	1891	2,526
Rapid-fire	164.7	6.48	1881	2,132
Do	164.7	6.48	1884	2,132
Breech-loading	164.7	6.48	1887	2,625
Do	164.7	6.48	1887 (short plug).	2,296
Do	164.7	6.48	1891	2,625

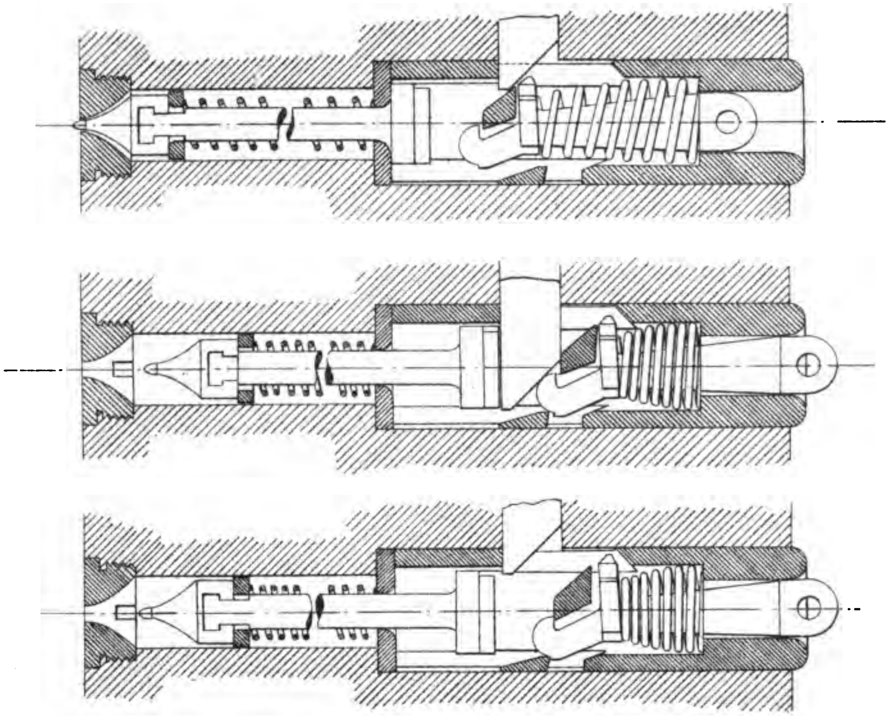

Fig. 3. PERCUSSION LOCK AS FITTED TO THE CONVERTED 100, 138.6 and 164.7 mm. R. F. G.

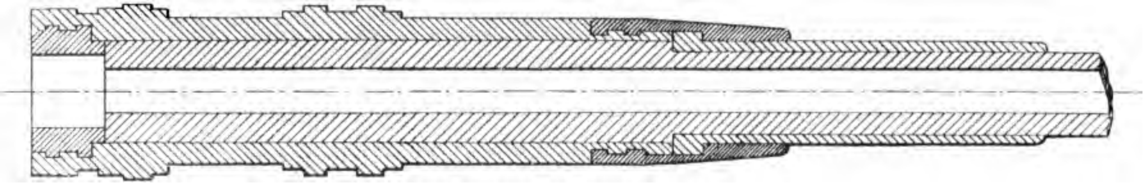

Fig. 4.—194 millimeters.

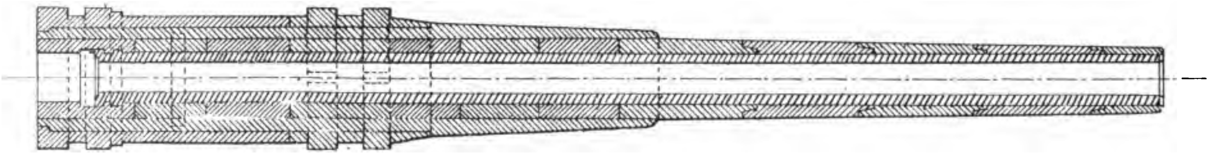

Fig. 5.—274.4 millimeters.

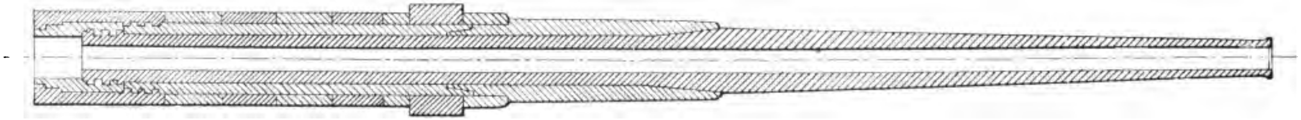

Fig. 6.—164.7 millimeters.

GUNS FITTED WITH VIROLES. (FERRULES.)

Guns of the model of 1892, without trunnions, are 50 calibers in length, while those of 100 millimeters, model of 1892 (Canet system), are 55 calibers.

A peculiar feature of the construction of guns of the model of 1884 of 164.7 millimeters (6.48 inches) and upward, except the 240 millimeters (9.45 inches), is the introduction of a short tube (*virole*) in the breech for the purpose of increasing the length of the screw box and strengthening the gun. To effect this in case of the 194-millimeter (7.647-inch) caliber (*see* fig. 4) the rear end of the tube is cut off and the *virole* is screwed in, abutting against the end of the tube of the gun. The rear half of this receives the breech plug. Figs. 5 and 6 show another method in which the *virole* is screwed on the tube. R. F. G. of 100, 138.6, and 164.7-millimeter (3.94, 5.45, and 6.48-inch) calibers, L/45, without trunnions, are altered in this manner.

DEVELOPMENTS OF CANET GUNS.

The changes introduced in design in the past few years refer chiefly to reducing the number of parts, to increasing the length of the bore, and to alterations in the nature of the rifling, the dimensions of the powder chamber, etc. Attention has also been especially given to insure ample longitudinal strength. The main objects in view have been, and still are, to reduce the size of calibers of ships guns, to increase the velocity of projectiles of moderate weight, to flatten trajectories, and, of course, to widen the area and depth of the dangerous zone commanded by the high velocity and long-range guns. M. de Vignaux, of the Forges et Chantiers de la Méditerranée Company, in a recent lecture, dwells upon the importance of a low trajectory, suggesting that, although its advantages are beyond dispute, its vital importance is not yet sufficiently recognized. Fewer changes in elevation are required with a flat trajectory in following a moving object; and this is a matter of great importance, since the gunner can deliver a larger number of shots in a given time—one of the important conditions of modern warfare—without having his attention diverted by having constantly to change the angle of elevation. Securing increased velocity is a subject to which the Forges et Chantiers de Méditerranée Company have paid special attention. To increase the velocity there are two conditions that must be fulfilled, the employment of very slow powders especially adapted to the gun in which they are to be used, contained in a chamber of suitable proportions, and a lengthening of the bore sufficiently to allow the expanding gases to perform a maximum of work through a comparatively long distance. Experiments were referred to (p. 99, No. XIII) in which very high velocities were obtained with a gun of ten centimeters (3.94 inches), L/80. It is stated that subsequently an experimental French naval gun of the same dimensions gave to its projectile a muzzle velocity of 1,200 meters (3,936 foot-seconds). It has been proved that guns of these extreme lengths can be made and used without being exposed to excessive strains. It seems probable that the proportion of 30 or 35 calibers will become obsolete. M. de Vignaux admits the impossibility of mounting such long guns, even those of 45 or 50 calibers, on ships designed to carry the older or shorter models, and he advocates meeting this difficulty by constructing vessels to suit the guns, and not to adapt the latter to the confined limits now provided. This authority considers that the advance made has been sufficiently great to justify the substitution of the 24-centimeter (9.4-inch) for the 27-centimeter (10.6-inch), and of the 19-centimeter (7.5-inch) for the 24-centimeter (9.45-inch). This reduction of caliber brings with it a considerable diminution in the weight of the gun, the mounts, and the ammunition, in the dimensions and consequently the weight of the turret armor, and that of the ammunition hoists.

An obvious advantage in the reduction in the weight of guns and mounts is that it facilitates the working by hand in place of hydraulic or other power. It appears probable that in the French navy hydraulic power for handling heavy guns is to be superseded by electricity. Of this type of artillery the Forges et Chantiers de la Méditerranée establishment has produced good examples, and, moreover, so designed that the whole operation of training, supplying ammunition, loading, etc., can readily be performed by hand, in the event of a breakdown of the power installation, with but little delay and without overtaxing the strength of the crews. This advantage has been achieved by reductions in the weight of the guns and the mounts, and by a careful balancing of the turret and the gun.

Regarding the storage of ammunition M. de Vignaux makes some interesting observations. He says that the most important point to be cared for is to avoid high temperatures in the magazines. Many experiments have proved that brown powders, in the course of time, suffer considerable changes and become more violent and sudden in their action. This peculiarity has led to serious accidents in the French and English services. Recently investigations have been conducted with smokeless powders with a gun-cotton base. The danger appears to be much greater with the nitroglycerin powders, from which exudations are likely to occur. Technical opinion in France seems to lean to the desirability of artificially cooling the magazine. It is claimed that the temperature should never exceed 35° C. (95° F.), and that this should be maintained by ventilation and cold-air circulation, or preferably by the installation of a special cooling plant to maintain the temperature at safe limits.

In addition to careful stowage, ships using ammunition of this class will probably be provided with appliances for testing the powder from time to time.

Regarding the installation of the battery M. de Vignaux emphasizes the following points:

1. The necessity of reducing the number of different calibers on board, as any slight loss in offensive power would be more than com-

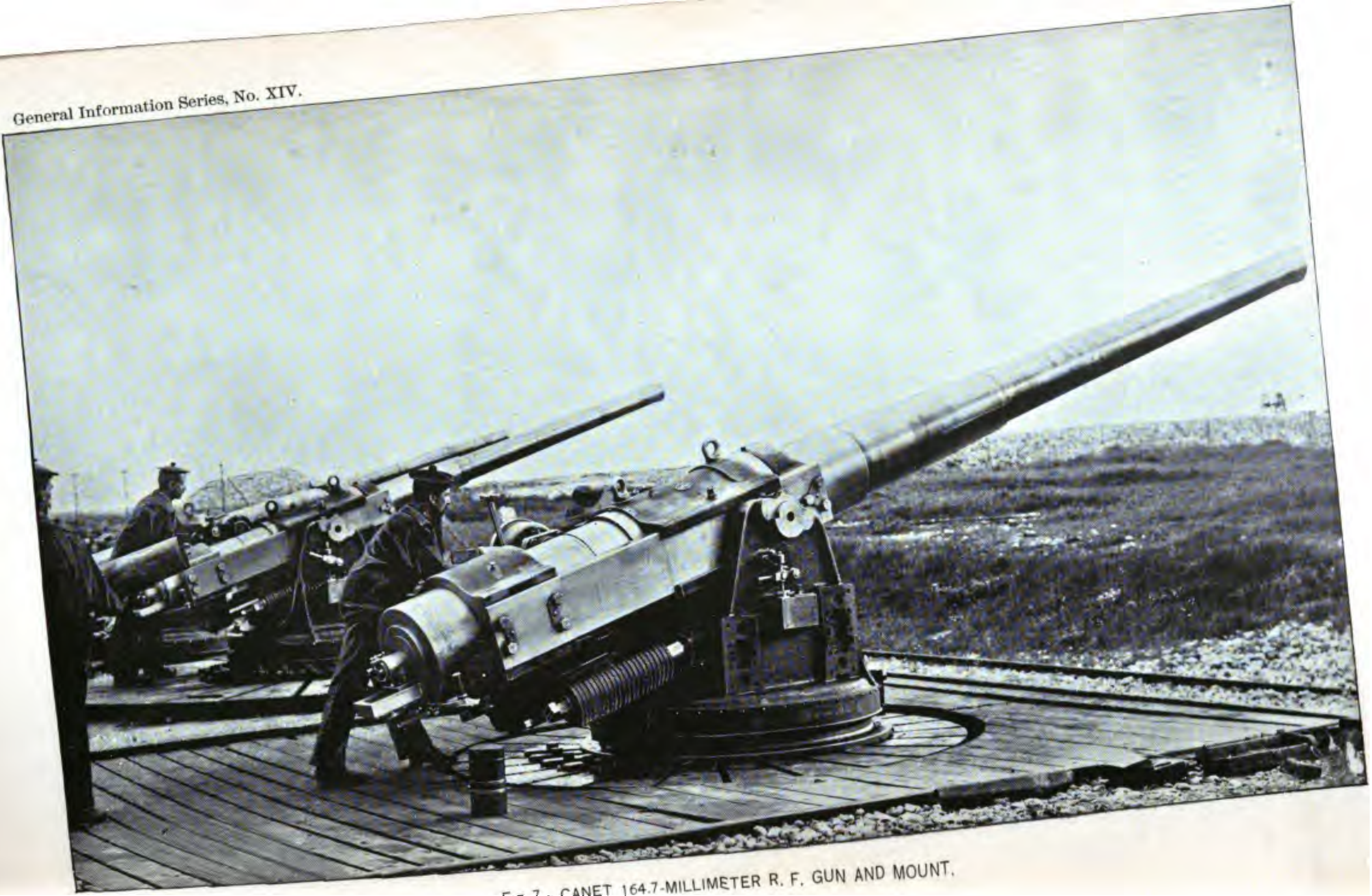

Fig. 7.—CANET 164.7-MILLIMETER R. F. GUN AND MOUNT.

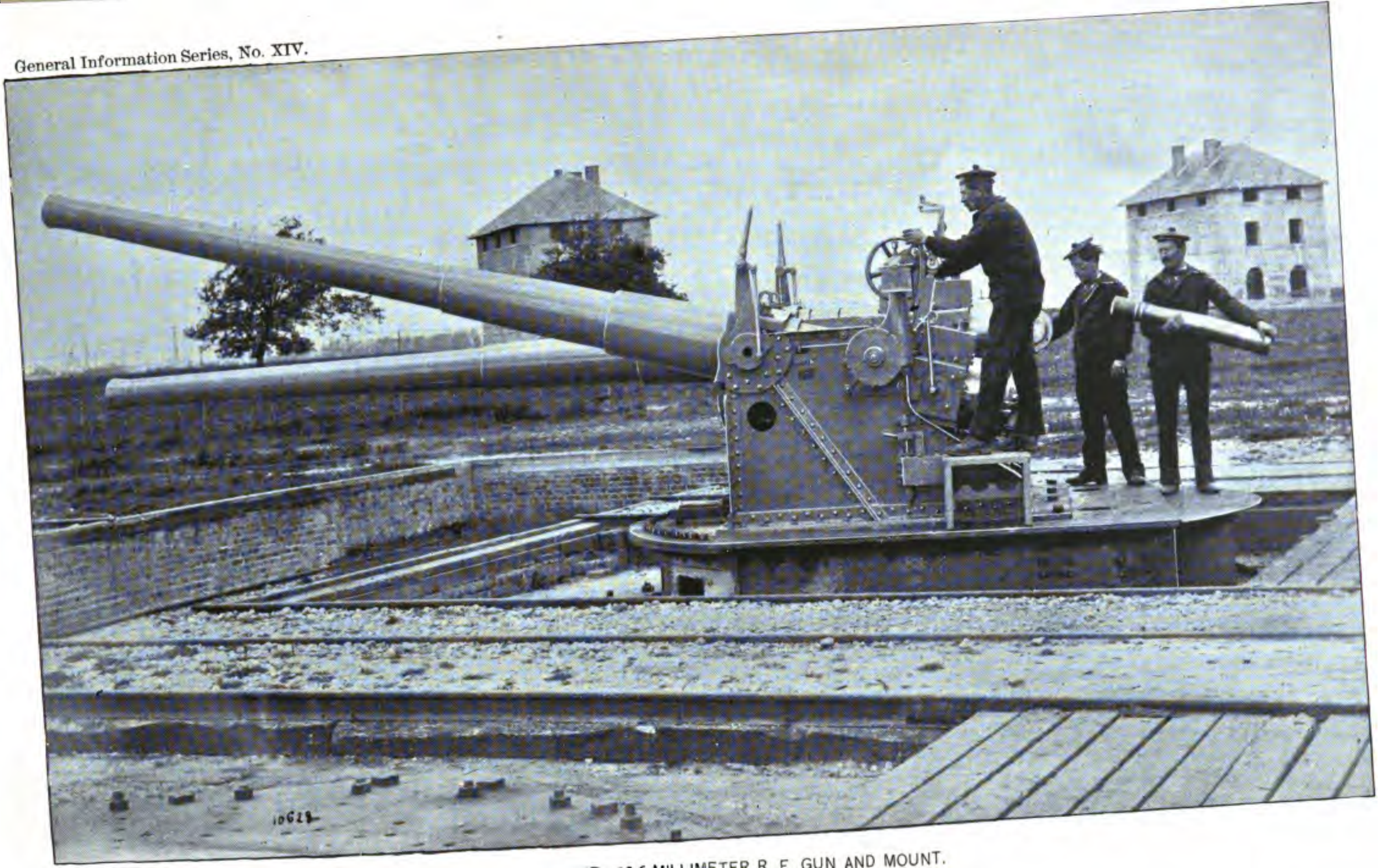

Fig. 8.—CANET 138.6-MILLIMETER R. F. GUN AND MOUNT.

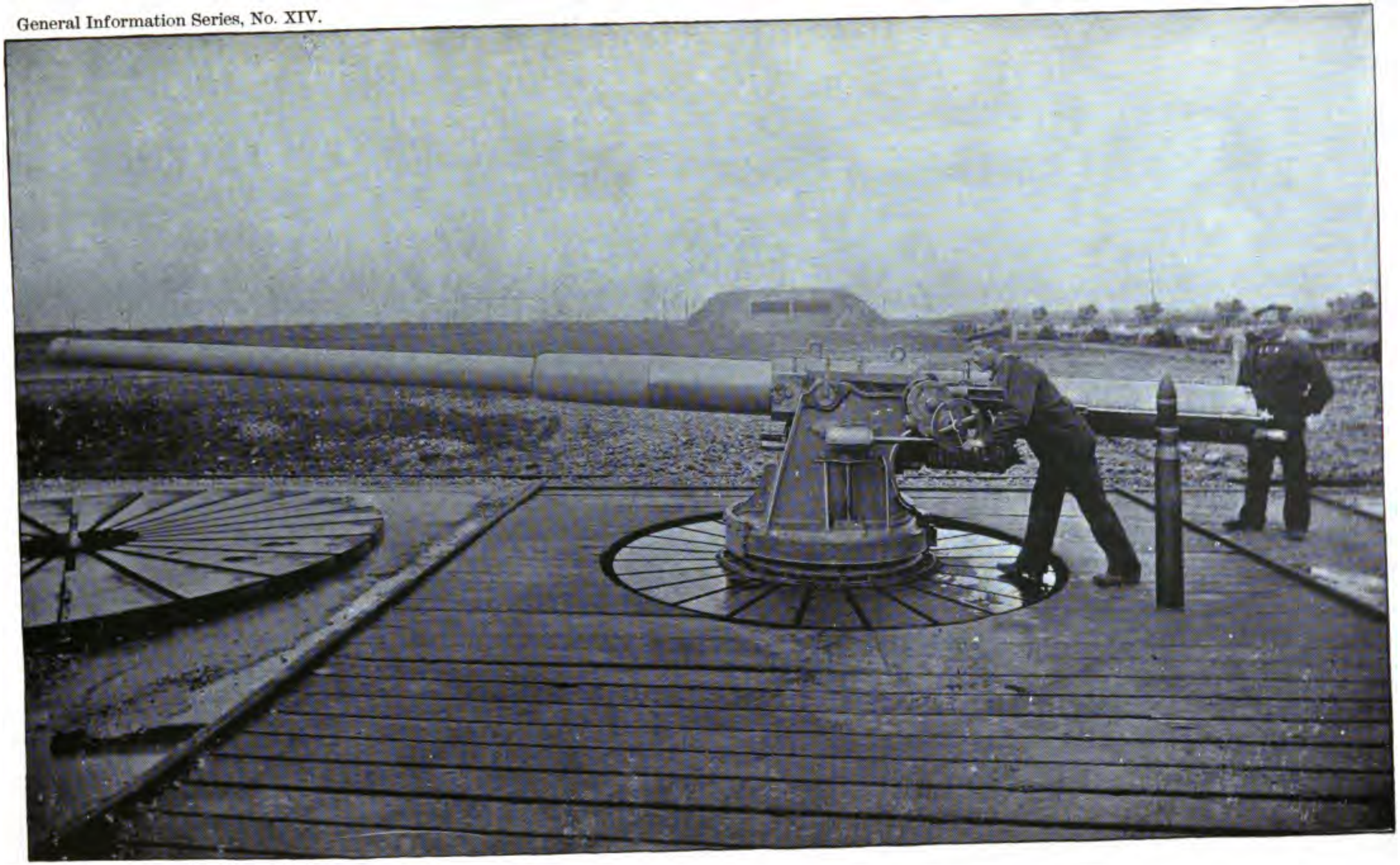

Fig. 9.—CANET 10-CENTIMETER L/80 R. F. GUN.

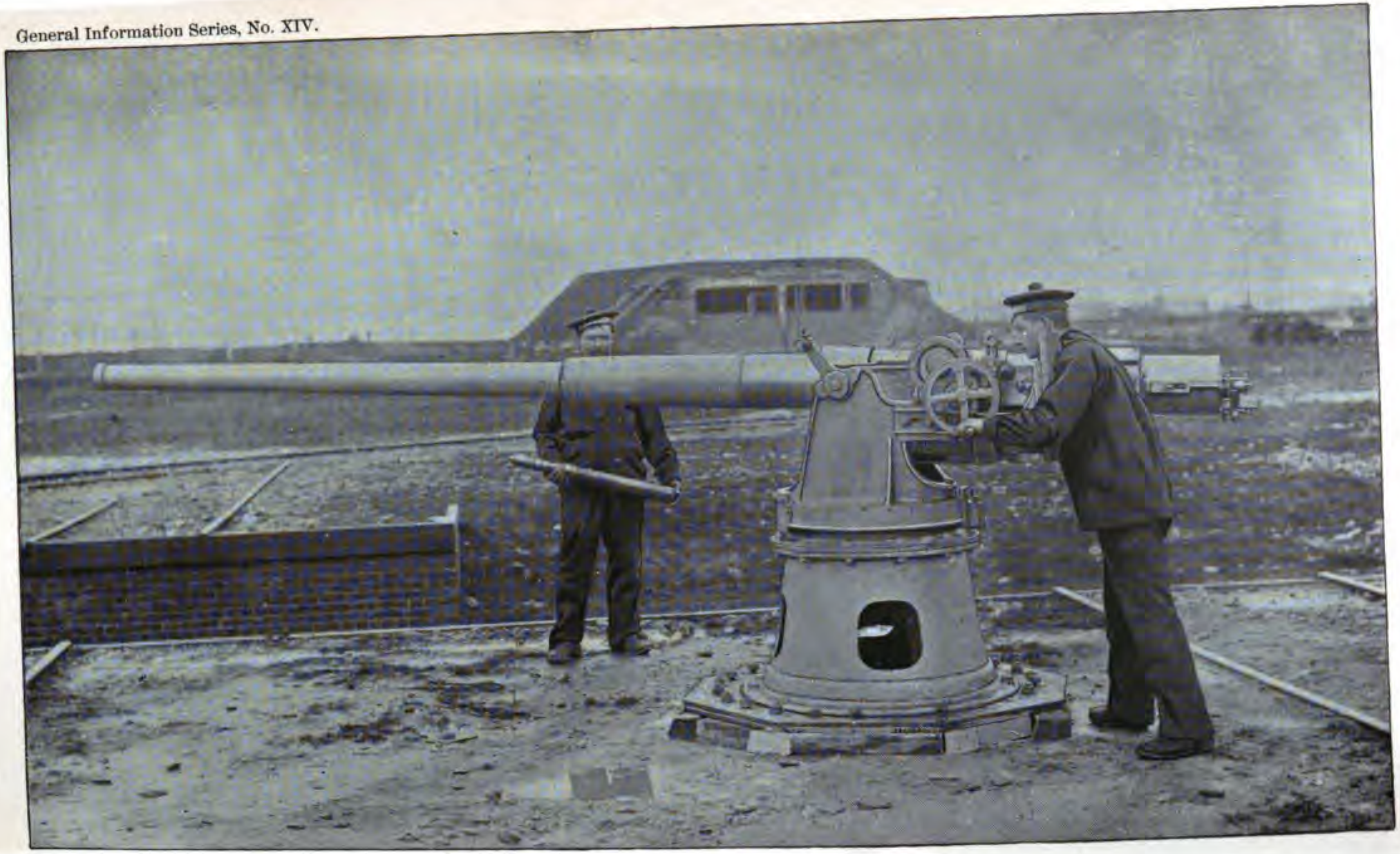

Fig. 10.—CANET 57-MILLIMETER L/80 R. F. GUN.

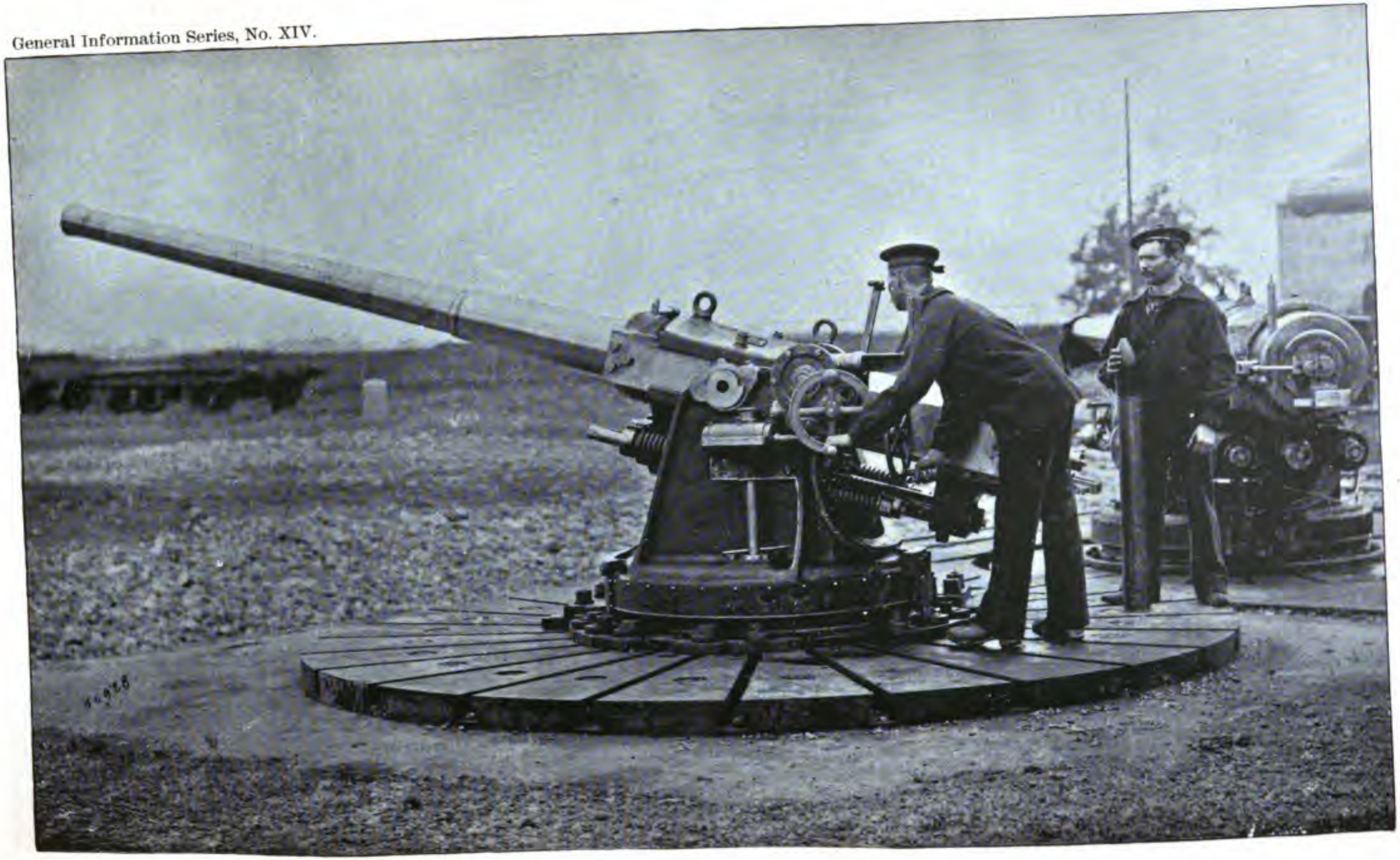

Fig. 11.—CANET 10-CENTIMETER R. F. GUN AND C. P. MOUNT.

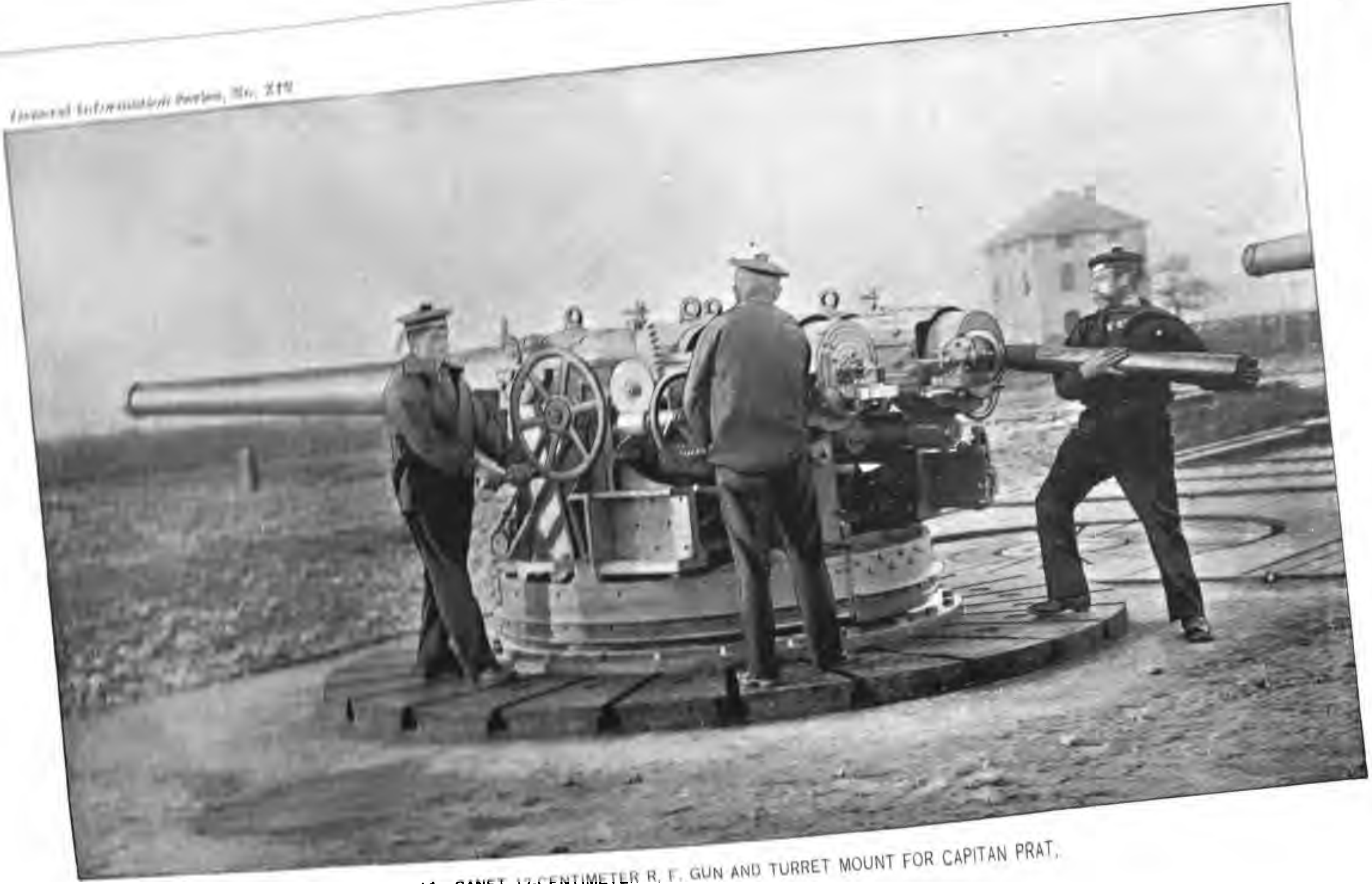

Fig. 12.- CANET 12-CENTIMETER R. F. GUN AND TURRET MOUNT FOR CAPITAN PRAT.

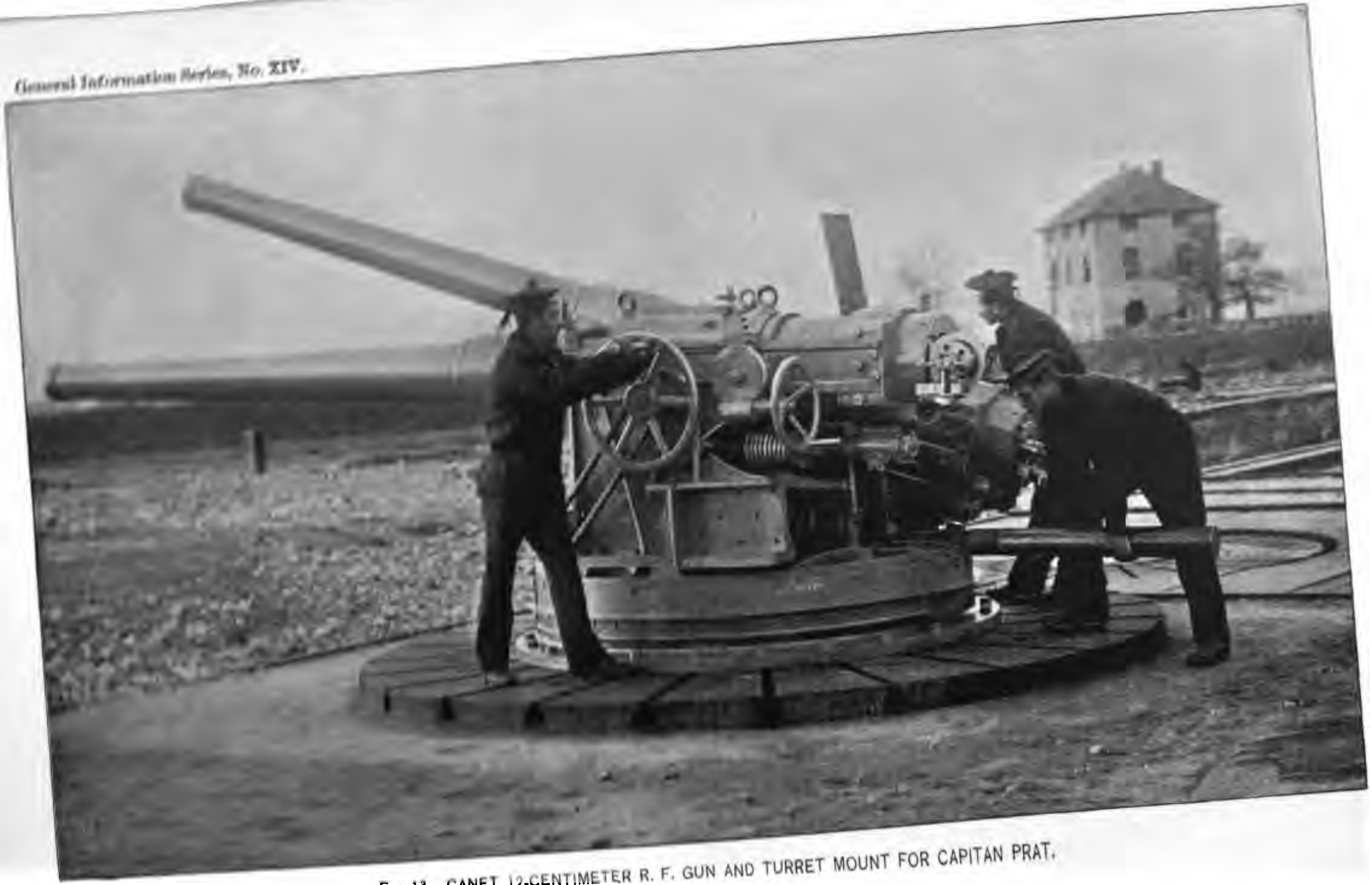

Fig. 13.—CANET 12-CENTIMETER R. F. GUN AND TURRET MOUNT FOR CAPITAN PRAT.

pensated by the advantages arising from a smaller variety of ammunition, etc.

2. It becomes more and more necessary that the ship should be designed for its armament. If this armament be not installed under the best available conditions, if the guns interfere with each other's angles of fire, if the men serving the guns are hampered by want of room or imperfect appliances, rapid firing is impossible. In order to compare the fighting values of two ships' armaments this arrangement of the battery and the facility with which the guns are handled are points which require careful consideration. The following is a list of the elements that have to be considered in making the calculation: (1) The various calibers, and with them the weights of projectiles. (2) The initial velocities. (3) The number of guns constituting the armament. (4) The number of rounds that can be fired by each caliber in a certain time. (5) The field of fire of each gun. (6) The ease with which the various guns can be trained. (7) The accuracy of fire and the chances of useful firing, a condition which obviously varies in large calibers and in rapid-fire guns. (8) The speed of the ship and her manœuvring power. After all, the most useful information is the total striking energy. To obtain this the armament may be classified as follows: (1) Large caliber guns. (2) Rapid-fire guns of from 10 to 16-centimeter (3.9-inch to 6.3-inch) caliber. (3) Rapid-fire guns of less than 10 centimeters (3.9 inches). The guns can not all be fired at once, so their efficiency depends, to a large extent, on the manner in which they are arranged and how many can be concentrated on a given object. Moreover, it must be remembered that the value of fire from different kinds of guns varies in other respects besides that of foot-tons of striking energy. A rapid-fire gun, even of a moderate caliber, may easily throw a greater weight of metal with a higher energy in a minute than a 34-centimeter (13.4-inch) gun can do, but it would be very misleading to estimate the former at the same value as the latter. It may be greater or less, according to circumstances. Therefore, in establishing comparisons between the battery powers of different ships it is necessary to classify the different types of guns and to reduce them to a unit of time. Taking one minute as this unit, the following practical firing speeds, under service conditions, may be taken:

Caliber.	Rounds per minute.
24 centimeters (9.45 inches)	.5
19 and 20 centimeters (7.47 and 7.87 inches)	.75
15 and 16 centimeters (5.90 and 6.29 inches)	5
12 and 14 centimeters (4.72 and 5.51 inches)	6
10 centimeters (3.94 inches)	7
65 millimeters (2.56 inches)	10
57 millimeters (2.24 inches)	12
47 millimeters (1.85 inches)	13
37 millimeters (1.46 inches)	15

With this method of comparison it is possible to show approximately the effect of substituting rapid-fire guns for the slower-fire guns of large caliber. It is evident that such a change must not be carried too far, because war ships, cruisers for example, should be provided with some guns as heavy as those to which they are likely to be opposed.

The preceding table nearly agrees with the service rates of fire as used in making comparisons in the Office of Naval Intellegence, which are as follows:

Caliber.	Rate of fire under service conditions.
12 inches	1 round per 6 minutes.
10 inches	1 round per 6 minutes.
8 inches	1 round per 3 minutes.
6 inches	2.5 rounds per minute.
5 inches	6.5 rounds per minute.
4 inches	8.5 rounds per minute.
6-pounder (2.24 inches)	11 rounds per minute.
3-pounder (1.85 inches)	12 rounds per minute.
1-pounder (1.46 inches)	15 rounds per minute.

Touching this subject the following comparison of the battery power of nine different ships is interesting on account of the introduction of a time element:

Name of ship.	Displacement.	Number of rounds per minute (all calibers).	Total striking energy per minute.		Striking energy per ton of displacement.	
	Tons.		*Meter-tons.*	*Foot-tons.*	*Meter-tons.*	*Foot-tons.*
Capitan Prat	6,990	46.50	41,147	132,900	5.880	19
Presidente Pinto	2,080	23	27,632	89,251	13.280	42.89
Nueve de Julio	3,550	39	46,626	150,600	13.140	42.44
Veinte cinco de Mayo	3,200	34.75	34,005	109,836	10.620	34.30
Blake	9,000	32.50	59,287	191,497	6.588	21.28
Barfleur	10,500	33.50	43,684	141,100	4.160	13.43
Dupuy de Lôme	6,300	30.75	34,265	110,675	5.349	17.28
Brooklyn	9,180	18.75	62,784	202,780	7.819	25.25
Piemonte	2,480	23	49,602	160,214	20.041	64.73

The policy of increasing the rapid-fire armament and reducing the number of very heavy guns is being followed in France in the design of ships such as the armored cruisers *Dupuy de Lôme*, *D'Entrecasteaux*, and the *Jeanne d' Àrc.* Associated with this modification are the improvements in the guns themselves. The middle calibers most commonly used are the 100, 138.6, and 164.7 millimeters (2.9, 5.5, and 6.5 inches), the latter representing the extreme limit for a "R. F. G." as the term is applied in France.

FIELD GUNS.

The work of replacing the French field artillery has begun, and according to the French press will be carried on not only in the national gun factories, but in private establishments, so that the new pieces may be delivered without delay. The Cail factory, at Paris, is engaged in this work under the direction of Captain Piffard. The gun which has been adopted is that of Colonel Duport. It consists of two pieces, a cylindrical tube about 8 feet 6 inches long and 2.95 inches in caliber, wholly enveloped at the breech end by a jacket about 3 feet long into which the breech plug engages, which is described as of a modified Nordenfelt and as exceedingly simple in construction. It is stated that this gun will fire from 12 to 15 rounds a minute, using fixed ammunition.

NORDENFELT R. F. G.

Two types of breech mechanism characterize the Nordenfelt system. That which is fitted to a 75-millimeter (2.95-inch) field gun of new pattern is shown in fig. 14. The details of construction are clearly indicated in fig. 15.

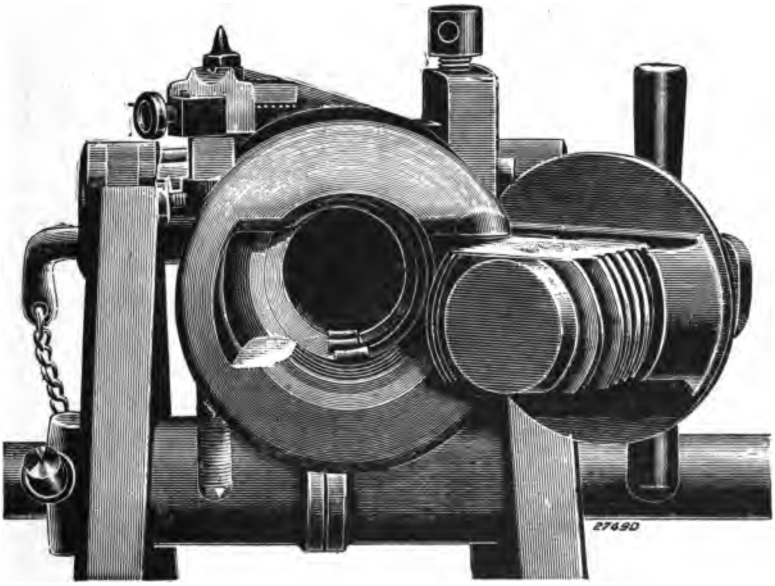

FIG. 14. ENGINEERING.

Particulars of new Nordenfelt field gun, heavy type.

Caliber	75 mm. = 2.95 in.
Length of bore, including chamber	26 calibers.
Total length of gun	2.094 meters = 82.44 in.
Number of grooves	24.
Width of grooves	7 mm. = 0.28 in.
Depth of grooves	0.05 mm. = 0.02 in.
Distance between sights	1 meter = 39.37 in.
Weight of breech mechanism	15 kilos = 33 lbs.
Weight of gun with mechanism	300 kilos = 660 lbs.
Ratio of weight to projectile	51.28.
Preponderance on elevating screw	5 kilos = 11 lbs.

The rifling is not uniform; from the chamber to one-fourth the length of the bore it has an angle of 2 degrees and 19 minutes, and beyond the angle is increased to 6 degrees. The weight of the projectile is about 13 pounds; the muzzle velocity is 1,640 feet. The lighter type of gun fires a projectile weighing 11 pounds, with an initial velocity of 1,475 feet.

Particulars of new Nordenfelt field gun, light type.

Caliber	75 mm.=2.95 in.
Length of bore, including chamber	24 calibers.
Total length of gun	1.944 meters=76.53 in.
Number of grooves	24.
Width of grooves	7 mm.=0.28 in.
Depth of grooves	5 mm.=0.02 in.
Distance between sights	800 mm.=31.50 in.
Weight of breech mechanism	15 kilos=33 lbs.
Weight of gun with mechanism	250 kilos=550 lbs.
Ratio of weight of gun to projectile	50.
Preponderance on elevating screw	5 kilos=11 lbs.

On page 100, No. XIII, mention was made of a R. F. G. fitted with a Nordenfelt breech mechanism. Fig. 16 shows a mount intended for a fortification. It is termed a "*caponnière*" mount, and designed for a 57-millimeter (2.24-inch) R. F. G., and represents the application of the universal ball joint. The elasticity of the plates absorbs the recoil. The embrasure is thus protected from splinters, and smoke is excluded. Figs. 17 and 18 show cone mounts for the 65-millimeter (2.56-inch) and the 47-millimeter (1.85-inch) rapid-fire Nordenfelt guns.

Particulars of Nordenfelt R. F. G., light calibers.

	Caliber.			
	2.56 inches.	2.24 inches.	1.85 inches.	1.46 inches.
Length of bore, including chamber........calibers..	50	46	46	46
Total length of gun........inches..	134.84	108.66	90.55	70.47
Weight of—				
Gun........pounds..	1,186.1	734.1	485	160.9
Carriage........do....	676.8	458.6	326.3	165
Cone........do....	771.6	451.9	330.7	154
Shield........do....	209.4	180.8	174.2	132
Thickness of shield........inches..	0.28	0.28	0.28	0.28
Weight of gun and carriage........pounds..	2,844	1,825	1,316	613
Length of recoil........inches..	7.08	5.90	3.94	3.15
Weight of—				
Cartridge case........pounds..	3.506	1.719	1.100	0.55
Charge (smokeless powder)........do....	1.278	0.760	0.418	0.176
Projectile........do....	8.8	5.996	3.3	1.65
Initial velocity........feet..	2,296	2,112	1,968	1,968

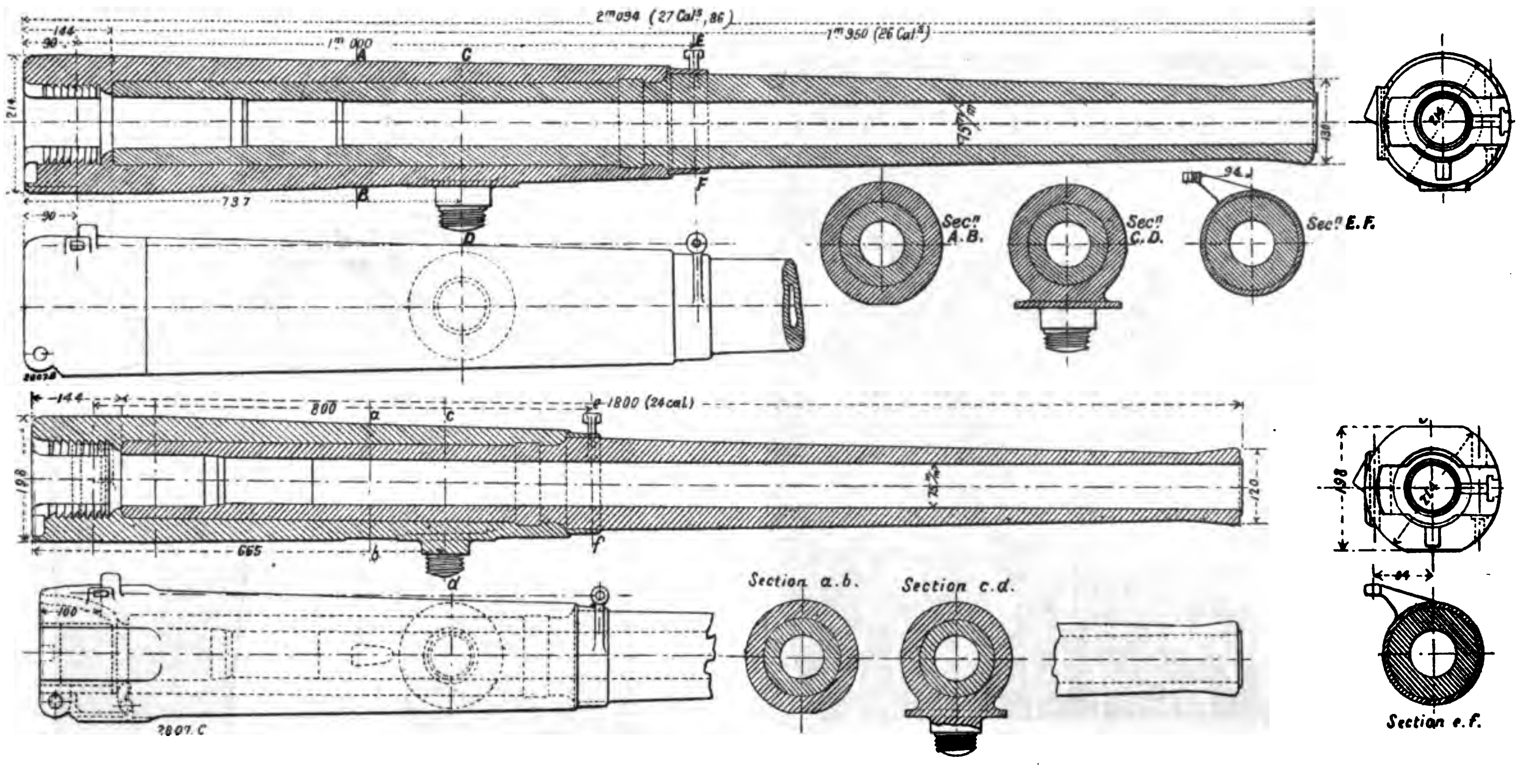

Fig. 15. NORDENFELT 75-MILLIMETER (2.95-inch) FIELD GUN.

ENGINEER.

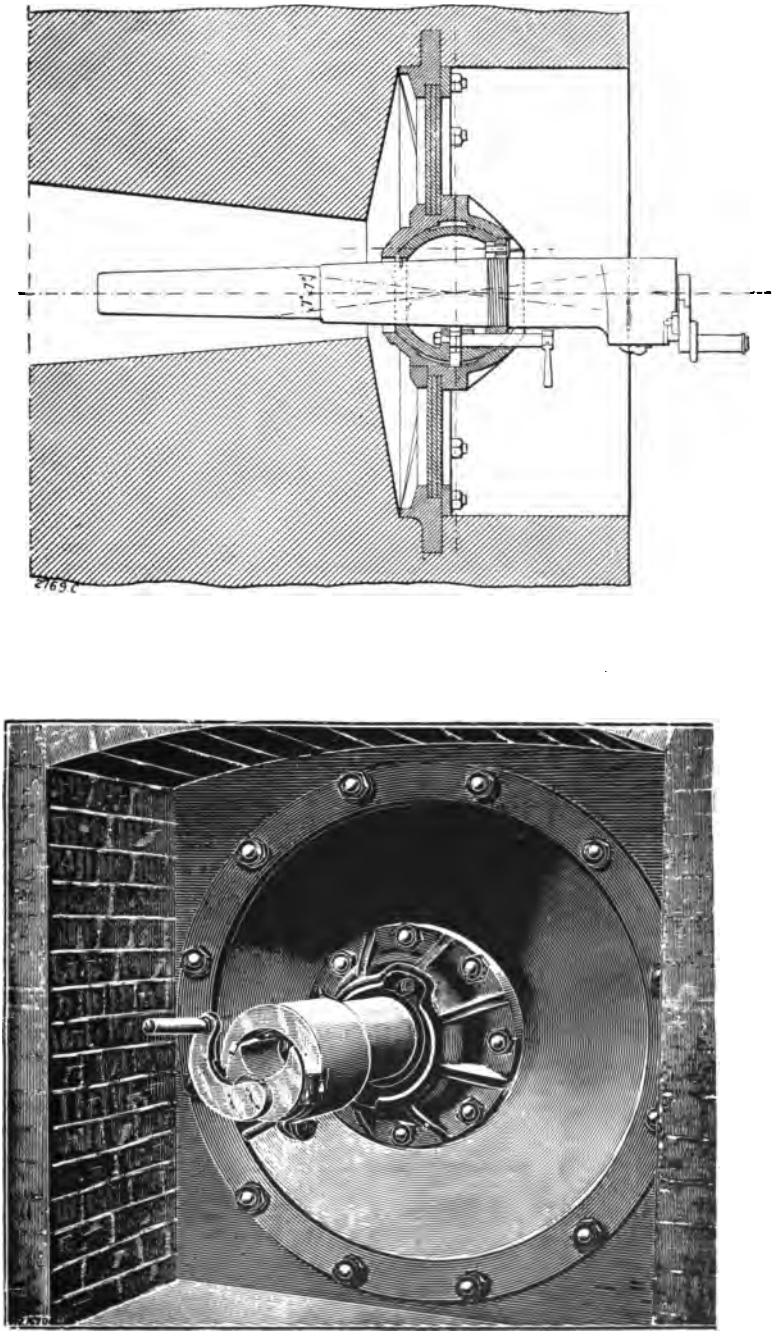

Fig. 16.—CAPONNIÈRE MOUNT FOR 57-MILLIMETER (2.24 INCH) NORDENFELT R. F. GUN.

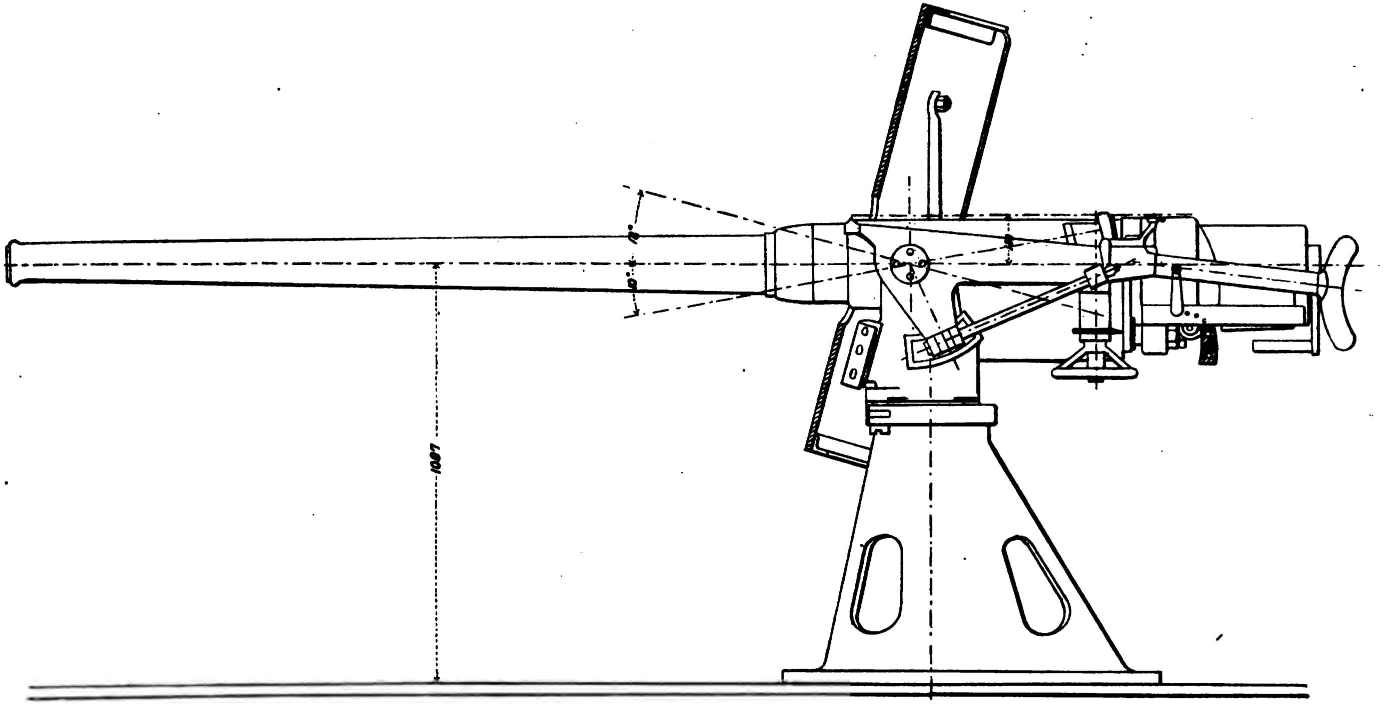

Fig. 17. CONE MOUNT FOR 65-MILLIMETER (2.56-inch) NORDENFELT R. F. G.

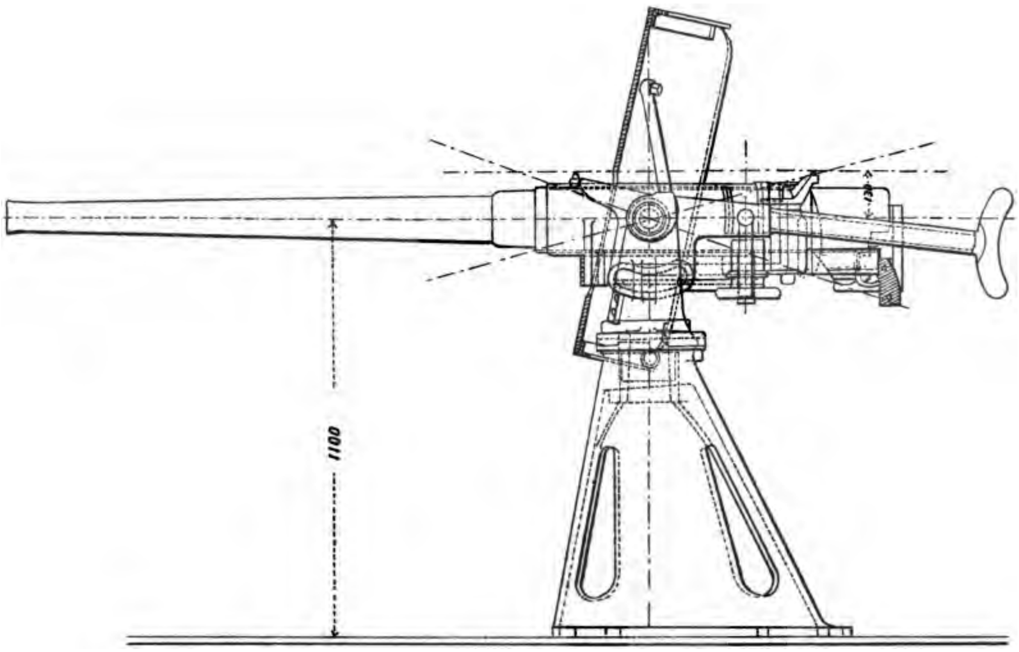

Fig. 18. CONE MOUNT FOR 47-MILLIMETER (1.85-inch) NORDENFELT R. F. G.

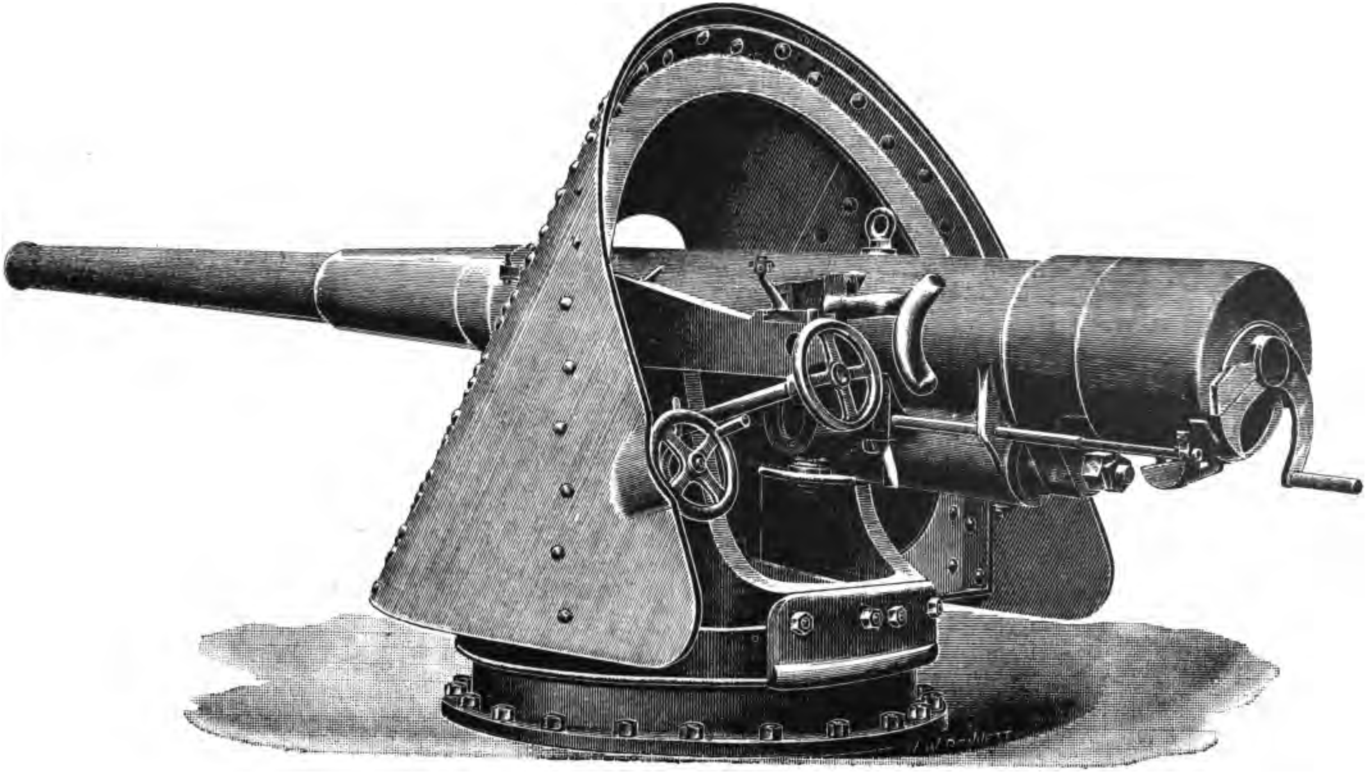

Fig. 19. 12-CENTIMETER (4.72-inch) NORDENFELT R. F. G. on C. P. Mount.

ENGINEER.

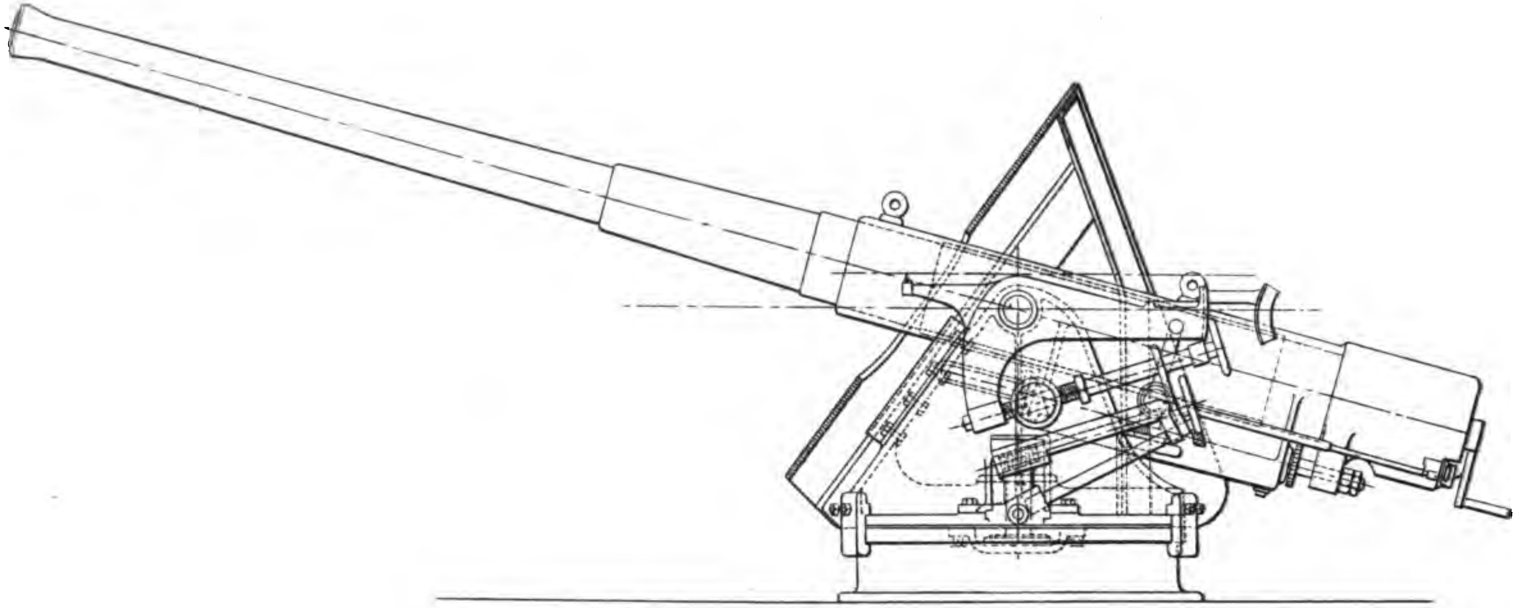

Fig. 20. 12-CENTIMETER (4.72-inch) NORDENFELT R. F. G. on C. P. Mount.

ENGINEER.

Particulars of the new Nordenfelt fortification, siege, and naval rapid-fire guns.

	Caliber.					
	138.6 millimeters.	5.51 inches.	120 millimeters.	4.72 inches.	100 millimeters.	3.94 inches.
Length of bore, including chamber.	45 cals	45 cals	46 cals	46 cals	50 cals	50 cals.
Total length of gun.	6.640 meters.	21 ft. 9.42 ins.	5.770 meters.	18 ft. 11.17 ins.	5.220 meters	17 ft. 1.51 ins.
Weight of—						
Gun	4,546 kilos	10,000 lbs	2,920 kilos	6,424 lbs	1,900 kilos	4,180 lbs.
Carriage without shield.	2,857 kilos	6,285 lbs	2,475 kilos	5,445 lbs	2,100 kilos	4,620 lbs.
Shield	1,465 kilos	3,223 lbs	855 kilos	1,881 lbs	800 kilos	1,760 lbs.
Thickness of shield.	20 mm	0.79 in	20 mm	0.79 in	20 mm	0.79 in.
Total weight of gun, carriage, and shield.	8,868 kilos	19,508 lbs	6,250 kilos	13,750 lbs	4,800 kilos	10,560 lbs.
Angles of elevation.	—5+20 degs.	—5+20 degs.	—5+20 degs.	—5+20 degs.	—8+20 degs	—8+20 degs
Length of recoil.	400 mm	15.75 ins	300 mm	11.81 ins	250 mm	9.84 ins.
Weight of—						
Cartridge case.	6.450 kilos	14.19 lbs	3.170 kilos	6.974 lbs	2.400 kilos	5.28 lbs.
Charge (smokeless powder.)	4 kilos	8.8 lbs	3 kilos	6.6 lbs	2 kilos	4.4 lbs.
Projectile	30 kilos	66 lbs	21 kilos	46.2 lbs	14 kilos	30.8 lbs.
Initial velocity	700 m.-secs	2,296 ft.-secs.	720 m. secs	2,361 ft.-secs.	720 m. secs	2,361 ft.-secs

Figs. 19 and 20 show a central pivot mount for a 12-centimeter (4.72-inch) Nordenfelt R. F. G. They also show the gun sights which are placed on the shoulder piece, and therefore do not recoil with the gun (p. 94, No. XI). The rear sight has no box for allowing movement in the vertical plane, but is permanently fixed to the shoulder piece, which when unclamped can be raised or lowered independently of the oscillating slide by revolving it around the left trunnion. In pointing, the freely moving shoulder piece is clamped to the oscillating slide, when an index shows upon a graduated arc the distance or elevation required, and the sights brought on by moving the shoulder piece, which moves gun and slide in the usual way. Fig. 17 shows the general method of the device. For the 4.72-inch gun, figs. 19 and 20, the elevating arc and its graduations are conveniently placed under the eye of the man at the shoulder piece. This system seems to provide a rear sight which can be expected to remain serviceable when kept in place upon the mount at all times.

The system of training by means of the sighting bar independently of the gun itself permits of rapid and accurate work. In training, the elevating screw raises or lowers the gun to the necessary amount for the distance, in relation to the sighting bar, which is laid direct on the target, and no readjustment of the rear sight is necessary. It will be seen that the top carriage rests on a circular cast-iron base, rollers being introduced between the two bearing surfaces, while the top carriage is held to the base by clips.

THE DARMANCIER 75-MILLIMETER (2.95-INCH) R. F. G.

A system of breech closure, known as the "Darmancier system," has been applied to R. F. G. constructed in France by the Compagnie des Hauts-Fourneaux, Forges et Aciéries de la Marine et des Chemins de Fer.

The breech is opened by a circular movement of the plug lever crank through 180 degrees to the right, when the plug is free to swing back in its collar. This operation in its various stages is illustrated in fig. 23, *a*, *b*, *c*, *d*. The primer seat (or firing pin) is on the plug lever, and is not in line with the vent until the plug is entirely closed (*b*, *a*). Firing can not take place until this position is attained. The details of the plug mechanism are shown in fig. 24, and the gun on a field carriage in fig. 25.

Some details of two types are given in the following table:

	Light gun.	Heavy gun.
Caliber { inches	2.95	2.95
Caliber { millimeters	75	75
Weight of projectile ... pounds	14.3	14.3
Number of balls in the shrapnel	332	332
Bursting charge ... ounces	3.5	3.5
Muzzle velocity ... foot-seconds	1,740	1,970
Weight of—		
Gun ... pounds	770	920
Gun and carriage, without shield ... do	1,780	2,250

HOTCHKISS AUTOMATIC MACHINE GUN.

This gun is designed to fire any forms of service small-arm ammunition, and may be mounted on any type of carriage. The first round is fired by hand after which the operations of loading, firing, and extracting are carried on automatically, but under complete control of the operator. Slow fire may be delivered at any rate up to 100 rounds per minute, and rapid fire at the rate of from 500 to 600 rounds per minute. It is a single-barrel gun (*see* fig. 21), the essential feature of which is that the barrel is permanently fixed to the breech, none of the moving parts being subjected to the heat developed by the powder gas. This renders a water jacket superfluous and eliminates the danger of jams from expanded parts.

The mechanism comprises thirty-eight parts, exclusive of the sights, but including the barrel, shoulder piece, etc. There are four springs, viz, mainspring, sear spring, extractor and pawl spring, and no screws. The gun may be dismounted and assembled, with the exception of the barrel and the cylinder, without tools, a monkey wrench being necessary for these two parts only.

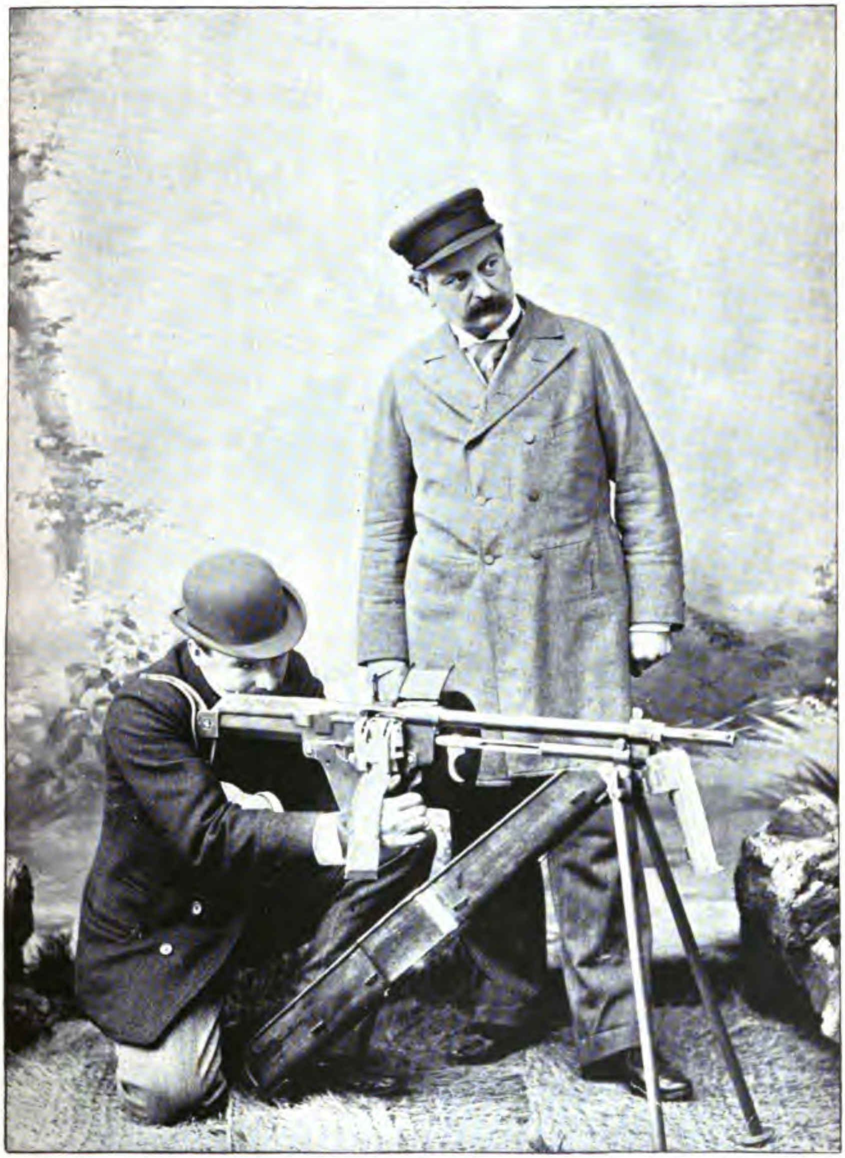

Fig. 21.—HOTCHKISS AUTOMATIC MACHINE GUN AND TRIPOD.

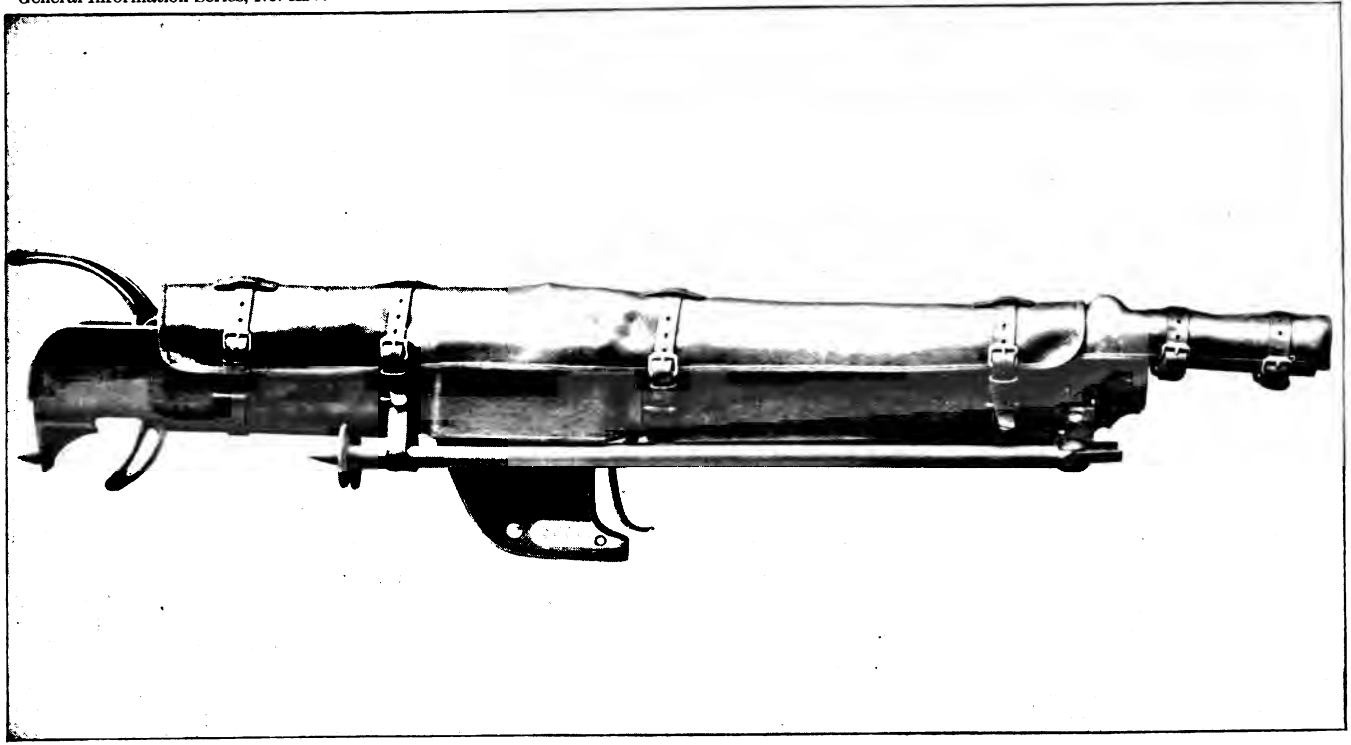

Fig. 22.—HOTCHKISS AUTOMATIC MACHINE GUN AND TRIPOD SECURED FOR TRANSPORTATION.

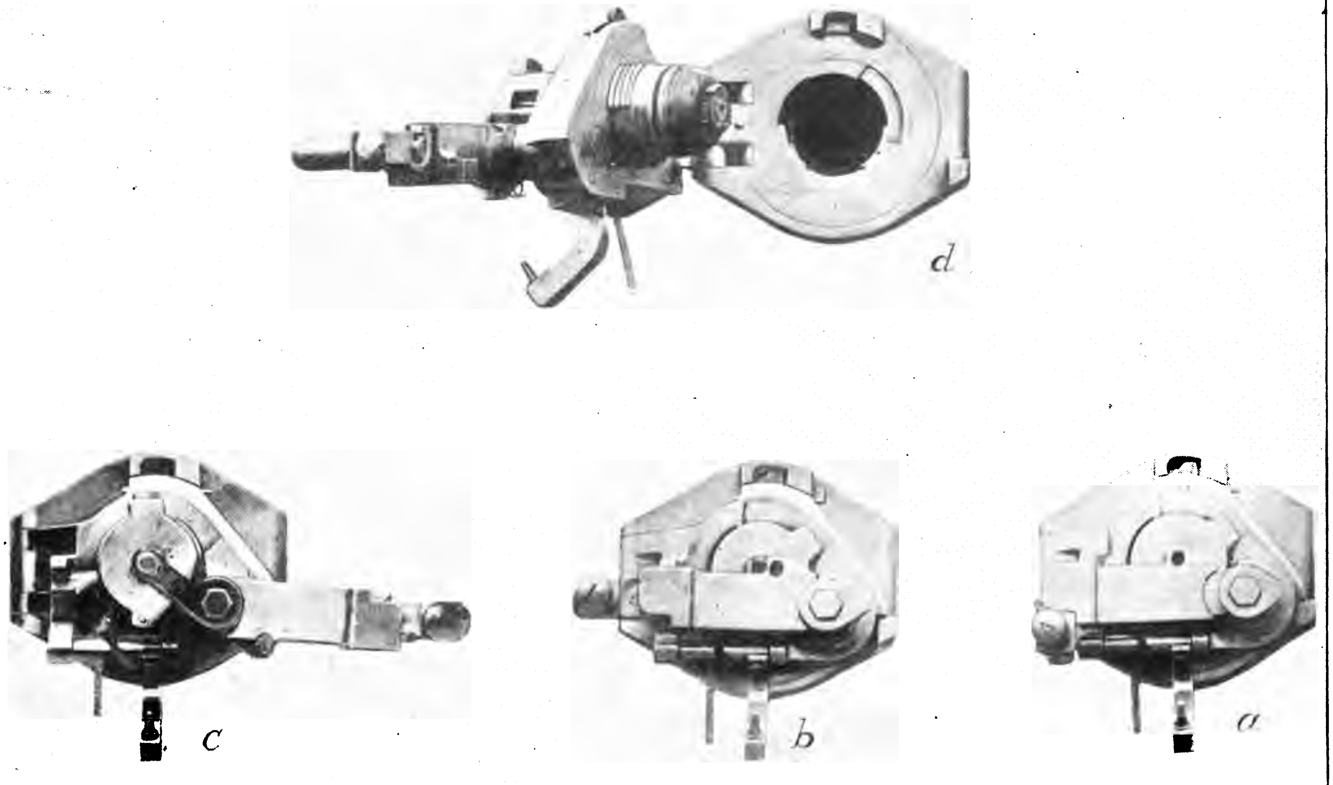

Fig. 23.—THE DARMANCIER BREECH PLUG.

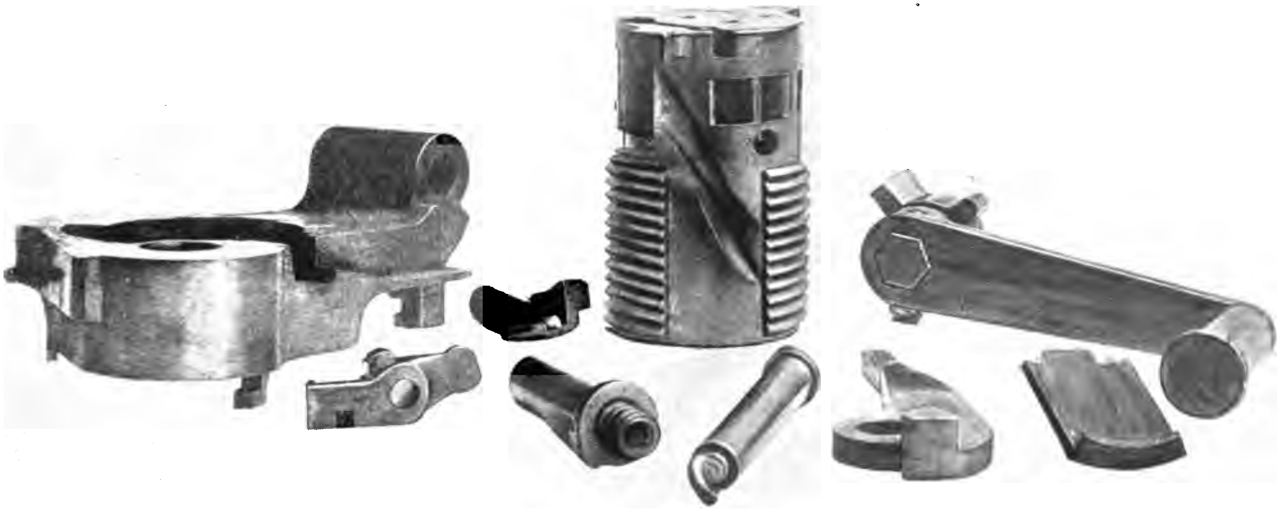

Fig. 24.—THE DARMANCIER BREECH MECHANISM.

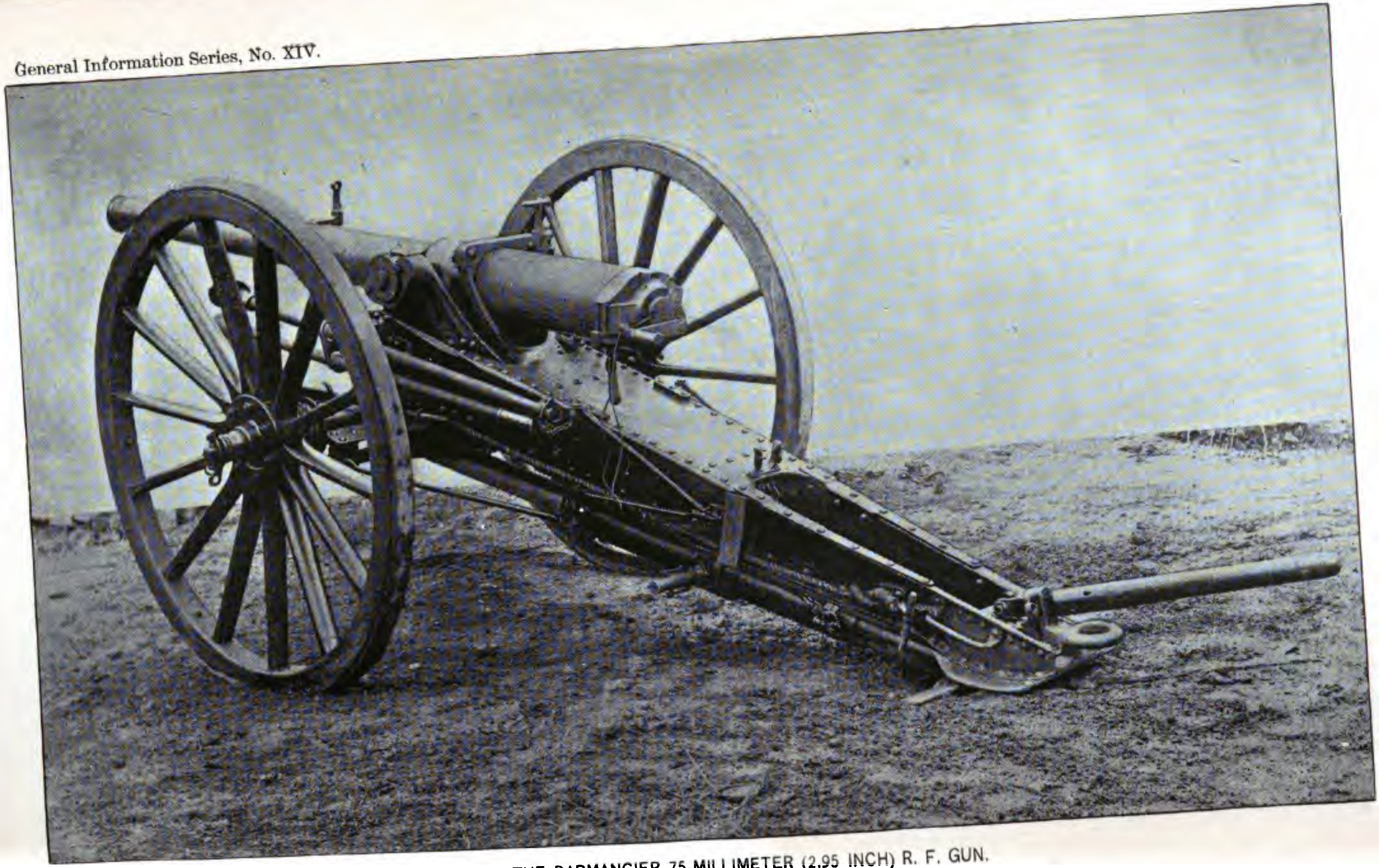

Fig. 25.—THE DARMANCIER 75-MILLIMETER (2.95 INCH) R. F. GUN.

The general action of the gun is thus described: Beneath and parallel to the barrel is fixed a small cylinder, which is in communication with the bore through a port drilled through the barrel a few calibers from the muzzle, to the rear of the cylinder is an exhaust port opening to the air. On the discharge of the gun, as soon as the bullet has passed the port connecting bore and cylinder, the powder gas enters the latter, throwing a long piston to the rear. When the piston has moved to the rear a given distance, thereby compressing the mainspring, the exhaust port is unmasked, permitting the gas to escape, and the piston is held in its backward position by an ordinary sear. On releasing the sear the piston is thrown forward to its original position by the mainspring. The piston by its motion opens and closes the breech, unlocks and locks the bolt, and fires.

The cartridges are packed in metallic clips, each containing 30 rounds. Each clip is packed in an ordinary pasteboard box, from which it may be fed directly to the gun.

The feed mechanism consists of a spur wheel, which engages in cams cut in the piston and in openings formed in the clip. It is so arranged that a clip may be engaged with the breech either open or closed. A safety lock is fitted to the piston, by which the mechanism may be locked with the breech closed or open. The gun complete weighs 20 pounds.

As shown in fig. 21, it is fitted with a belt feed and mounted on a light tripod designed for fieldwork. As thus mounted it may be compactly secured for transportation. (*See* fig. 22.)

GERMANY.

The German navy budget for 1895-96 includes the following appropriations: Ordinary permanent allowance for ordnance and fortifications, 4,957,111 marks ($1,174,792); for armaments, 5,515,400 marks ($1,312,665).

GREAT BRITAIN.

The navy estimates for 1895-96 show that the amount voted under the head of naval armaments is £1,693,200 ($8,239,957.80), an increase over last year of £310,000 ($1,508,615).

In the explanatory statement of the first lord of the Admiralty, accompanying the navy estimates for 1895-96, appear the following remarks on the subject of ordnance:

> The Admiralty have been alive to the importance of taking immediate steps to convert the ordinary 6-inch and smaller B. L. G. into quick-firing guns. * * * The progress of gun manufacture during the year has been satisfactory. The 12-inch wire guns have been tried with excellent results. Twenty-six of these guns are now either completed or in progress, and it is proposed to commence nineteen more in 1895-96. That number will complete the outfits and reserves of the nine battleships of the *Majestic* class.

The guns of the *Renown*, *Powerful*, and *Terrible* are in progress, and will be ready in good time.

The great importance of the quick-firing type of guns has been fully recognized, and the whole of the 6-inch and smaller guns now under construction are on that system.

With the exception of one second-class cruiser on a foreign station, all the ships built under the naval-defense act are now armed with these guns.

In October, 1893, experiments were commenced with the view of converting the 6-inch, 5-inch, and 4-inch breech-loading guns into quick-firers. These experiments having been carried to a successful issue, the conversion of a large number of guns has been undertaken. These guns will take the place of the ordinary B. L. G. in the battleships and cruisers not already armed with quick-firers.

Notwithstanding the explosion at Waltham Abbey, the production of cordite for the navy during 1894–95 will approach 450 tons. Steps have been taken to place orders with the private trade, and thus increase the area of supply. Cordite has been adopted for the new 12-inch and 9.2-inch guns, as well as for the quick-firing guns, and the reports of its behavior are very satisfactory.

BRITISH NAVAL ORDNANCE.

An inspection of a tabulated list of British ordnance will show the great variety of weapons which compose the gun armament of the navy. Not considering the muzzle-loading guns there are no less than twelve distinct kinds of ordnance above 4-inch caliber, of which the charges and projectiles differ entirely. Besides this many of the guns are of the same pattern, but different marks, the fittings of which are not interchangeable. This, doubtless, is owing to the rapidity with which the designing and construction of ordnance has progressed. There is a tendency to limit the number of the types of guns carried. The practice now is to arm battleships with 6-inch R. F. G. (designated quick-fire), together with the new 12-inch wire-wound guns. The *Renown* is an exception to this; she carries 10-inch. Similarly with the first and second class cruisers the 4.7-inch R. F. and 6-inch guns form the main armament, with only the exception that some of the first class carry 9.2-inch B. L., and even these are being superseded by the 6-inch guns of new type in the late first-class cruisers.

Gun.		Weight of projectile.	Weight of charge.		Remarks.
Caliber.	Weight.		Black powder.	Cordite.	
Inches.	*Tons.*	*Pounds.*	*Pounds.*	*Pounds.*	
16.25	111	1,800	960	....	
13.5	69	1,250	630	....	
12	46	714	259	....	
12	46	850	440	168	Wire-wound.
10	29	500	252	....	
9.2	22	380	140	....	
8	15	210	104	....	
6	4	78	34	....	
6	5	100	48	14.9	
5	2	50	15.5	4.5	
6	7	100	29.7	13.3	Classed as "quick-fire."
4.7	2	45	12	5.6	Rapid-fire.

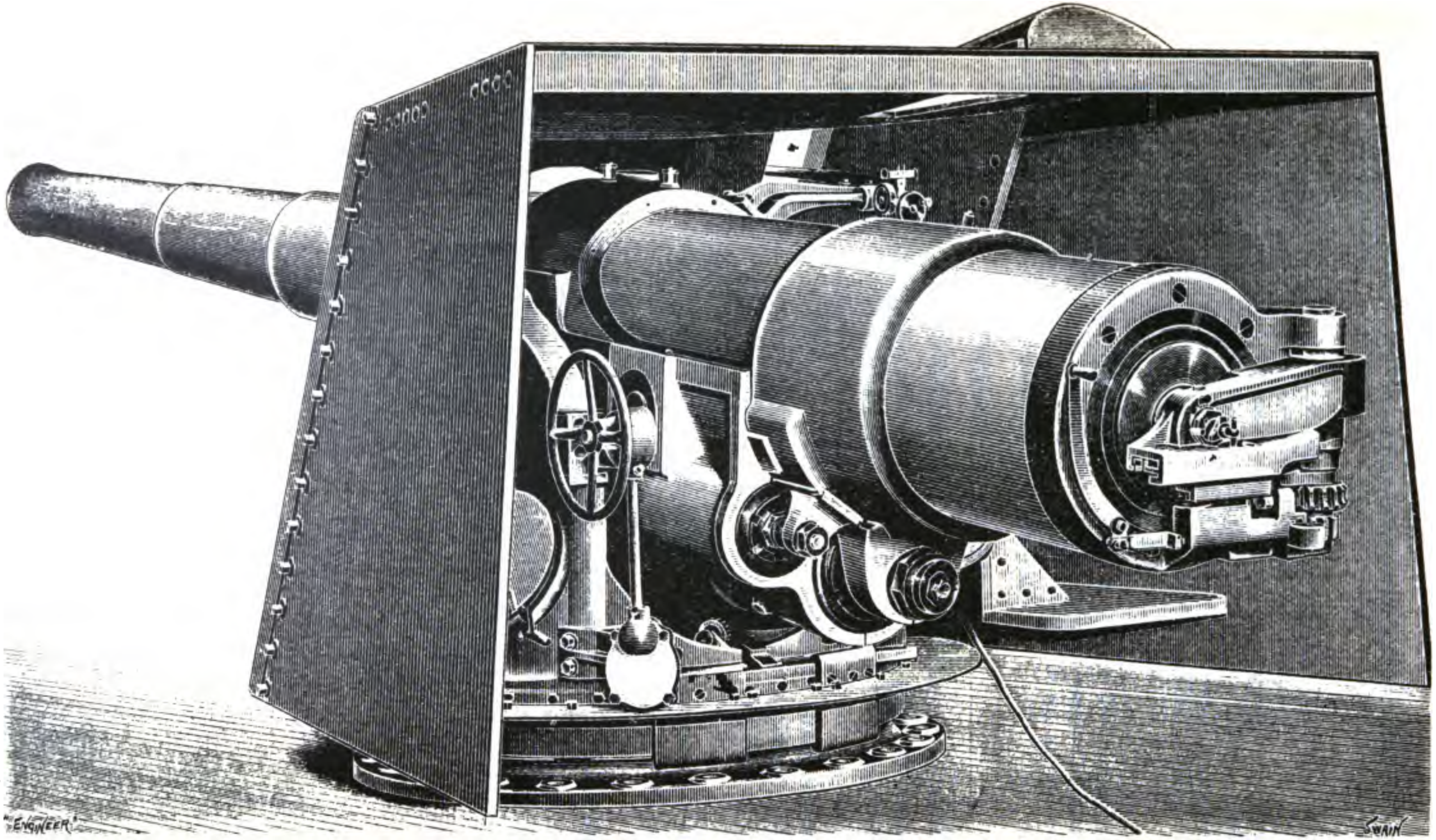

Fig. 26. 8-INCH ELSWICK R. F. GUN.

ENGINEER.

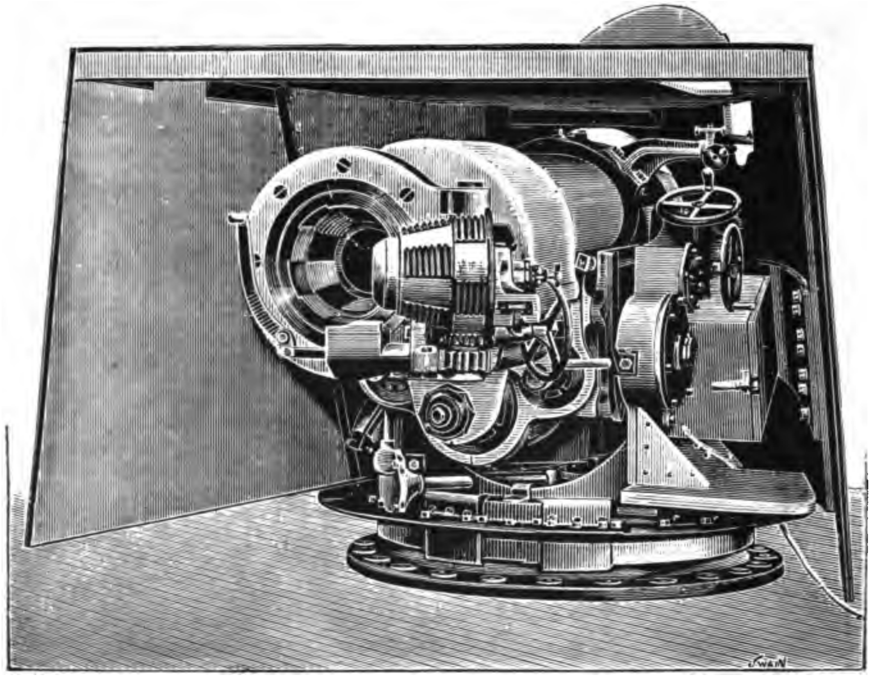

Fig. 27.

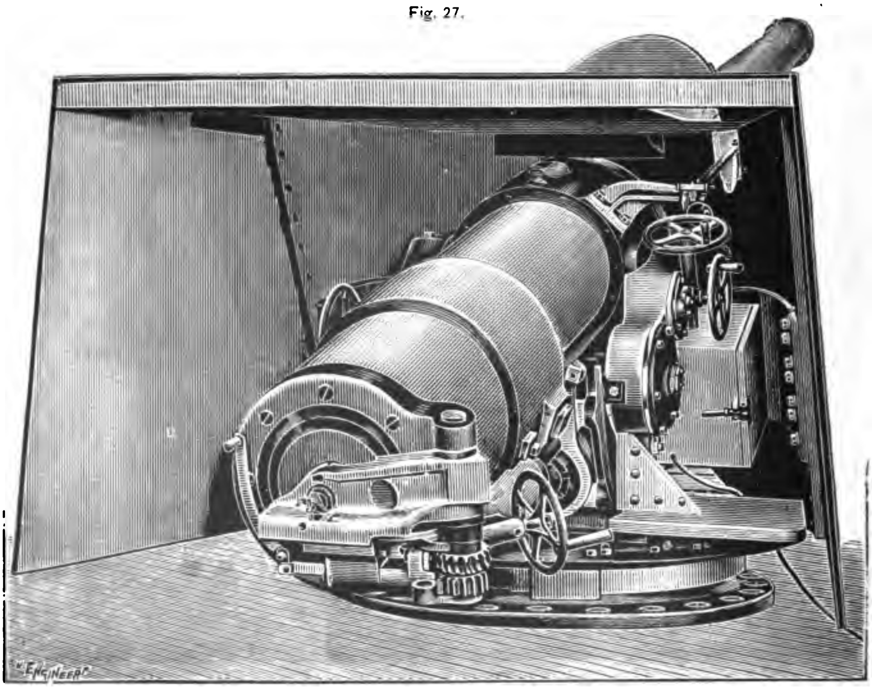

Fig. 28.

ELSWICK 8-INCH R. F. GUN.

Engineer.

WOOLWICH 12-INCH WIRE-WOUND GUNS.

The details of construction of this gun were given on page 81, No. XIII. The main advantages in this method may be thus summarized: (1) The certainty of there being no flaw in the material. (2) The initial tension can be regulated with the utmost nicety. (3) Steel wire has double the tensile strength of steel forged in tubes or hoops, and this increased margin of strength not only adds to the margin of safety, but will allow increased charges to be used without increasing the weight of the gun, and also provides a margin to meet sudden rise of pressure due to unforeseen circumstances, such as might occur with powders stored in hot magazines.

An official trial of the 12-inch wire-wound gun was recently made on board the gunnery ship *Excellent.* The advantages claimed for the mount are that every operation can be performed by hand as well as by hydraulic power. The guns may be loaded in any position. The mounts are balanced to reduce friction. Cordite charges alone were used at the trial, and the rounds were fired at various degrees of elevation and depression. The weight of the full charge was about 168 pounds, or about two-fifths that of gunpowder, and with superior ballistic effects. The volume of light-colored smoke produced was great, but it was instantly dissipated and left the range clear. The trial was reported to be satisfactory.

ELSWICK 8-INCH, R. F. G.

This piece, which is shown in figs. 26, 27, and 28, is of wire construction, and it is provided with automatic breech gear. It is fired with cordite charges, giving a service muzzle velocity of 2,660 feet to a projectile weighing 210 pounds. The description given of a similar gun on page 85, No. XIII, and plates, answers for this piece, except in a few particulars. Comparison will show that the counter-recoil cylinders have been placed below, and the right-hand one has a connection with a cog-wheel placed below the worm-wheel used for opening the breech by hand. The long lever on the left of the breech works the clutch which connects these wheels when it is desired to throw the automatic gear into action. If this automatic gear is in action the breech opens while the gun is running out.

For armor piercing a shot weighing 250 pounds is provided, which, fired with a battering charge, has a velocity of 2,670 feet, or, with an ordinary charge, 2,500 feet per second, the corresponding energies being 12,350 and 10,830 foot-tons, the perforation through iron being 29 and 27.1 inches, respectively. As to rate of firing, a former pattern, which was not fitted with automatic breech gear, is said to have been fired at sea from the Chilean protected cruiser *Blanco Encalada,* four rounds in 62 seconds, the ammunition being supplied from the magazine. The length of the gun is 45 calibers. The rifling is of the new

Elswick pattern, increasing from breech to muzzle, the final twist being one turn in 33 calibers. To close the breech it is only necessary to pull a line. The change from hand to automatic gear can be effected in about 5 seconds.

As with the mount described (p. 87, No. XIII), this gun may be trained by one man, although the revolving weight amounts to 42 tons. It is fitted with electric training gear. The same wheel is used whether training by hand or by electric power. The shield has a thickness of 4 inches, but the sides of the shield are prolonged to the rear by 1¼-inch plates, and the whole shield is so arranged that it balances about the axis of rotation of gun and mount. Such guns are to-day afloat on board of the Chilean protected cruiser *Blanco Encalada* (p. 147, No. XII, and p. 9, No. XIII), and the Argentine protected cruiser *Buenos Aires*.

SPAIN.

The Spanish Government are engaged in the conversion of their 14-centimeter (5.51-inch) L/35 B. L. R., model of 1883, to a R. F. G., using fixed ammunition. It is of the Hontoria design and weighs 4.1 tons. The breech mechanism is the interrupted-screw pattern with the De Bange obturator. The projectile weighs 88 pounds, which, with a battering charge of 44 pounds, has a velocity of 2,050 feet.

SWEDEN.

BOFORS 12-CENTIMETER (4.72-INCH) R. F. G.

The Bofors-Gullspang gun foundry is engaged in the manufacture of 12-centimeter (4.72-inch) guns and carriages for the navy. Some of the dimensions of this gun are as follows:

Caliber	inches	4.724
Total length	feet	17.7
Weight of gun	pounds	6,830
Weight of cradle	do	2,535
Weight of carriage and shield	do	5,379
Weight of projectile	do	44
Muzzle velocity (feet per second according to the powder employed)		2,395 to 2,723

The gun consists of a tube over which are shrunk a front and a rear jacket; into the latter the breech plug engages. There are 30 grooves, which increase in twist from one turn in 30 to one turn in 60 calibers.

The mechanism of the breech plug is composed of fourteen pieces. The plug is peculiar in that it is ogival in shape (*see* fig. 29). The plug is operated by a lever. On account of its shape no movement of withdrawal straight to the rear is required, the plug being swung out of the screw box on its carrier hinge as soon as the threads are disengaged. The first pull of the lever withdraws, cocks, and locks the firing pin. Extraction of the empty shell is performed automatically.

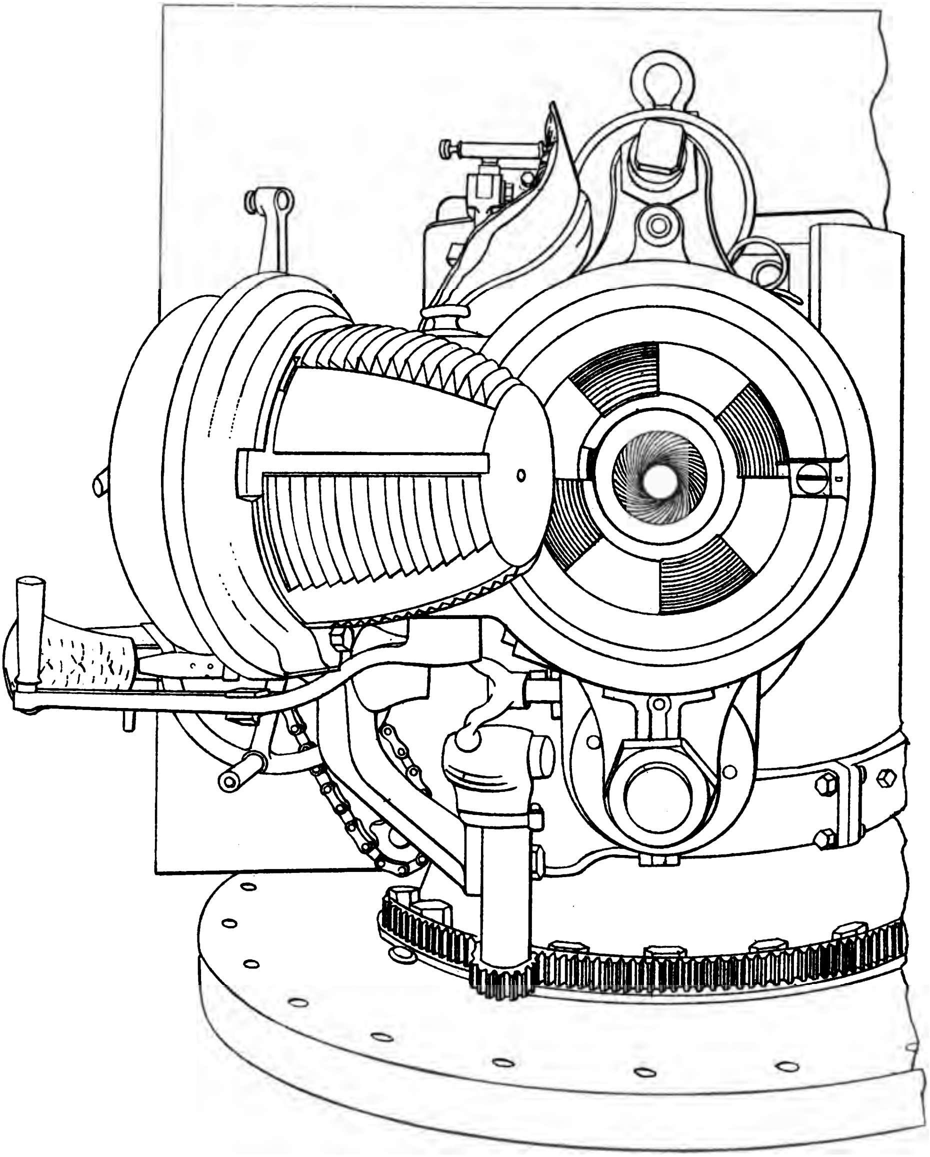

Fig. 29. BOFORS 12-CENTIMETER (4.72-inch) R. F. GUN.

REVUE D'ARTILLERIE.

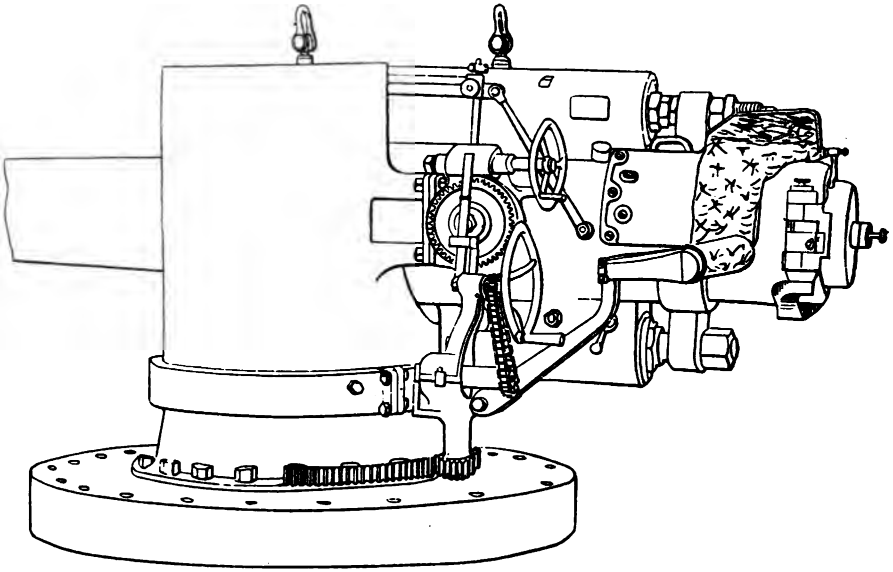

Fig. 30.—BOFORS 12-CENTIMETER (4.72 INCH) R. F. GUN.

Revue d'Artillerie.

In case a cartridge jams, a device enables the breech to be opened without bringing the extractor into action. The recoil is absorbed by a hydraulic cylinder attached to the gun underneath, and a cylinder on top contains heavy springs which cause the gun to return to battery after a recoil of 9.8 inches.

The carriage consists of a vertical steel cylinder, the wall being 3.93 inches thick, giving a certain amount of protection to the more delicate parts of the mechanism, such as the recoil cylinder, counter-recoil springs, and apparatus for sighting. The cylinder rests upon a central pivot, and the friction is reduced by the use of ball bearings. The gun can be elevated 15 degrees and depressed 7 degrees. The pointer steadies himself against a leather-padded cushion on his right, and holds the lock string or firing key in his right hand; conveniently situated near his left hand are the elevating and training wheels. This training gear, however, can quickly be disconnected by the man pointing so as to enable him to train the gun directly by means of a forked pointing bar which he bears against with his hips. (*See* fig. 30.)

The piece is ordinarily worked by a crew of four. The pointer handles the sighting, elevating, and training gear, and fires. The next number opens and closes the breech, the third removes the empty cartridge cases, and the fourth man loads.

The projectiles are of three kinds, viz, armor-piercing, canister, and common shell. A metallic cartridge case is used which weighs 10.6 pounds. Its capacity is only 390.5 cubic inches, which is too small to admit of the employment of a sufficient charge of black powder to obtain the initial velocity desired.

Three forms of Nobel powder, made near Stockholm, were tried experimentally. They gave satisfactory velocities. That prepared in grains gave the most uniform results.

The cases were used more than ten times without showing signs of deterioration. They were made in Germany, but the primers used in them were made at Bofors.

The rapidity of fire exceeded 10 shots per minute.

Charge.		Weight of projectile.	Initial velocity.	Maximum pressure.	Muzzle energy.	Penetration in wrought iron at muzzle.*
Kind of powder.	Weight.					
	Pounds.	*Pounds.*	*Foot-seconds.*	*Tons.*	*Foot-tons.*	*Inches.*
Black powder	15.4	44.4	2,018	16.51	1,198	9.8
Nobel powder:						
Rectangular, 0''.196 x 0''.393 x 0''.393	8.8	43.7	2,424	14.57	1,782	13
Rectangular, 0''.157 x 0''.315 x 0''.315	7.71	44.4	2,392	14.51	1,764	13
Leaf, thickness, 0''. 157; width, 1''. 968	11.2	43.9	2,726	15.03	2,266	15.3

* Calculated by Krupp's formula.

At the end of 89 rounds everything worked smoothly. A slight scoring of the lands was noticed, however.

AMMUNITION SUPPLY.

All the improvements to the gun and its mount looking to the saving of time in its manipulation, together with the modification in ammunition tending to the same end, makes the question of rapid ammunition supply one of vital importance. Its horizontal transportation is accelerated by the use of trollies and in new designs reduced to a minimum by locating the magazine and shell rooms as nearly as possible under the gun, or by having a secondary or "ready" magazine immediately below each gun. This reduces the question to one of hoisting, and various mechanical devices have been adopted to facilitate the operation.

In some foreign navies it is the practice to store a sufficient number of projectiles near each gun to supply it throughout an action of ordinary duration. This renders it unnecessary to provide for hoisting the heavier portion of the charge from below. Some of the Japanese officers who took part in the battle of the Yalu, while admitting the additional risk involved in carrying a large number of loaded shells on deck, considered this practice essential to the development of the full usefulness of the R. F. G.

ARMOR.

Various kinds of face-hardened armor are being manufactured abroad, differing more or less in processes used, but all of them possessing in common the features of, first, a carburization or cementation of one of the surfaces; second, a chilling of this face of the plate. At the present time the manufacture of f. h.* armor plates is being developed and improved so rapidly that it seems impossible now to deal satisfactorily with the question of perforation.

The formulas heretofore used, such as that of Noble, Krupp, de Marre, and others, which expressed the resistance to perforation to be expected from an armor plate are not applicable to face-hardened armor. All the formulas give results which are considerably in error at the high velocities which are now obtained, though they agree for velocities below 1,600 foot-seconds. With homogeneous plates the form of the formulas for penetration might still be retained by the use of new coefficients as long as the form of the shell remains but little changed during impact. The object of the hardened face is to break up the shell. It also prevents the flow of the softer metal to the front, so that the energy which is localized in this way is more widely distributed over the surface of the plate. If the shell is smashed, the manner of its breaking and the amount of energy it delivers to the plate before breaking are quantities so variable in their nature and amount that it would seem impracticable to express them or to allow for them in any formula for the penetration or for the perforation of armor plates. An exceptionally good armor-piercing shell may be expected, under certain circumstances, to perforate a face-hardened plate with but little deformation or breaking, and these cases, were they sufficiently numerous to give us the required data, could be made the basis of a formula for the perforation of face hardened plates. With the improvement of the armor-piercing shell, this will probably be done when the efficiency of the face-hardening process and the resistance of the face-hardened plate have become approximately constant quantities.

A shell which is capable of perforating a face-hardened plate with but little deformation or injury to itself would require for so doing a velocity not greatly in excess of that required for the perforation of an oil-tempered plate of good quality, while the velocity necessary to drive the fragments of a deformed and broken armor-piercing shell through the plate would be very greatly in excess of this amount.

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* "f. h." stands for face-hardened.

A nickel-steel Harvey plate 6 inches thick has been perforated by a 6-inch shell with a striking velocity of 1,700 feet, while it has required a velocity of from 2,000 to 2,100 feet to drive the fragments of another 6-inch shell through the same plate. This instance shows how impracticable it would be at present to formulate the resistance to be expected, under any given conditions, from face-hardened plates, the manufacture of which is being developed and improved, while the quality of the shell, which is the means of conveying the energy to the plate, and the tool by which the effect is produced, is a quantity whose variations are much greater than heretofore, owing to the fact that the resistance encountered is generally so great that the shell fails to act in a uniform manner. This resistance of a face-hardened plate to an armor-piercing shell is a quantity that either tries the shell nearly to its limit of strength or beyond this limit, more frequently the latter. Under these circumstances the differences in the shell cause greater apparent differences in their action and in the effects they produce.

FRANCE.

Reference was made (p. 149, No. XIII) to the trial of face-hardened plates 16 centimeters (6.3 inches) in thickness which took place at Gavre, April, 1894. Five other plates of 25 centimeters (9.8 inches) in thickness were submitted by the following manufacturers: The English firm of Vickers Sons & Co. and the French firms of St. Chamond, Creusot, Châtillon-Commentry, and Marrel Frères. The gun used was a 24-centimeter (9.45-inch) B. L. R. The projectile was of forged steel, weighing 317 pounds, with a striking velocity of 2,130 feet. The plates were all of the same dimensions, about 7 feet by 4.1 feet by 9.84 inches. They were secured to 33 inches of backing. The above striking velocity against a plate of this thickness corresponds (Gavre formula) to a ratio of 1.74, comparing the test plates with similar ones of untreated steel.

PLATE OF VICKERS SONS & CO.

The projectile passed through the plate, breaking up in so doing. A few pieces were recovered in the backing. Four large cracks were developed extending radially to the four edges, splitting it in two pieces through its length.

ST. CHAMOND PLATE.

Two shots were fired at this, the second with a velocity reduced to 1,990 feet. Each broke up, but perforated the plate. No cracks were developed.

CREUSOT PLATE.

The projectile perforated the plate, breaking up. A few pieces were recovered in the backing. The plate developed three radial cracks starting from the impact.

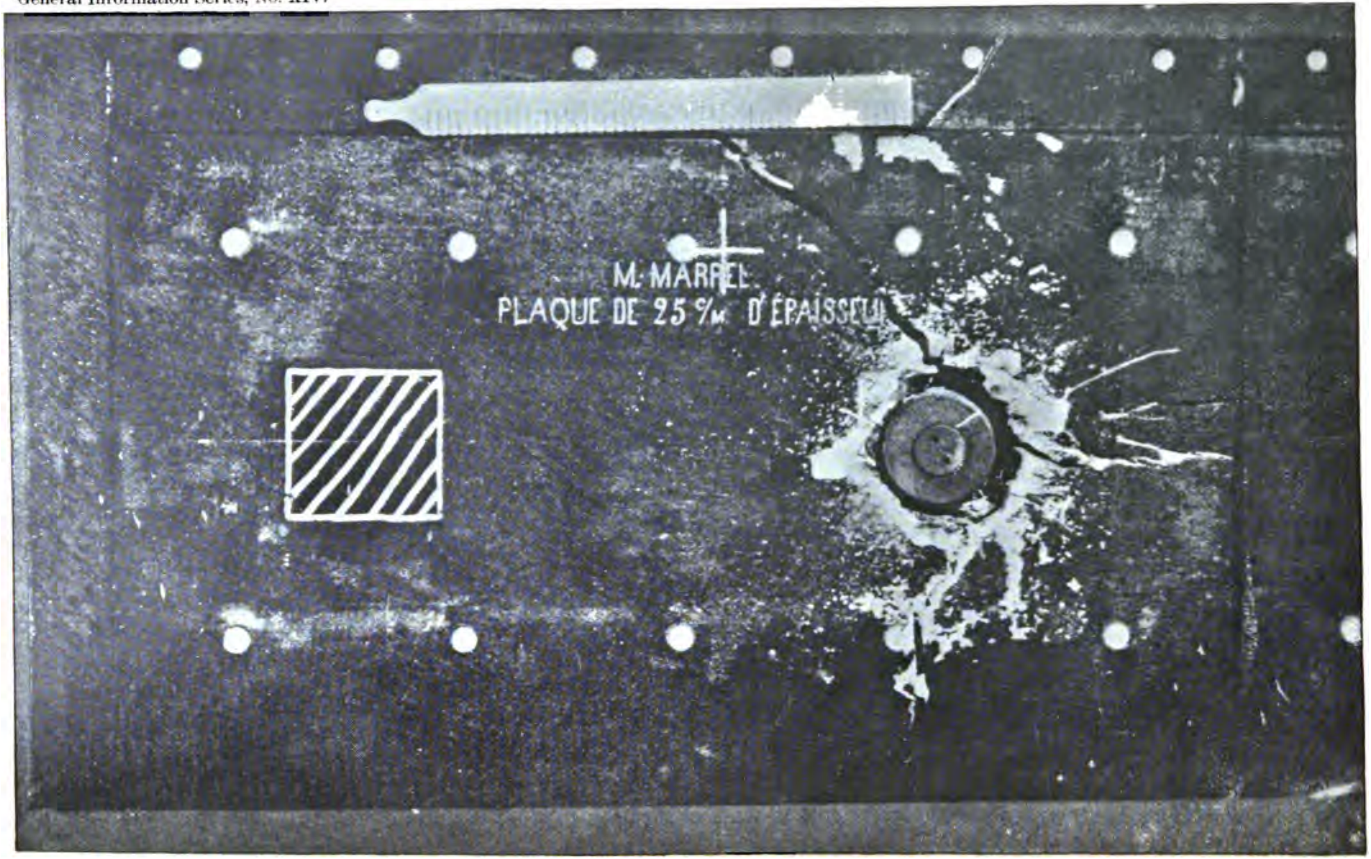


Fig. 1.—MARREL HARVEYED PLATE.

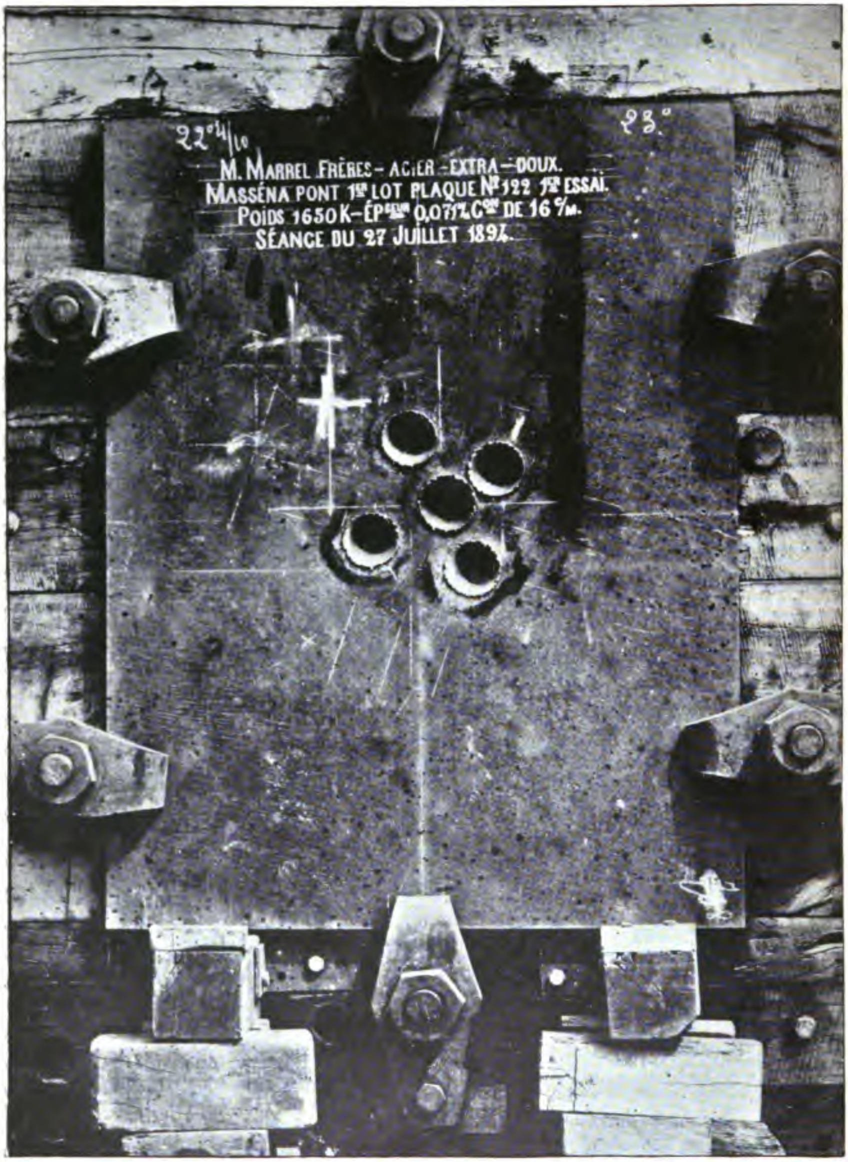

22°4/10
23°
M. Marrel Frères – Acier – Extra – Doux.
Masséna Pont 1er Lot Plaque No 122 1er Essai.
Poids 1650 K – Épeur 0,07½ Con de 16 c/m.
Séance du 27 Juillet 1897.

Fig. 2.—MARREL FRÈRES DECK PLATE. FRONT VIEW.

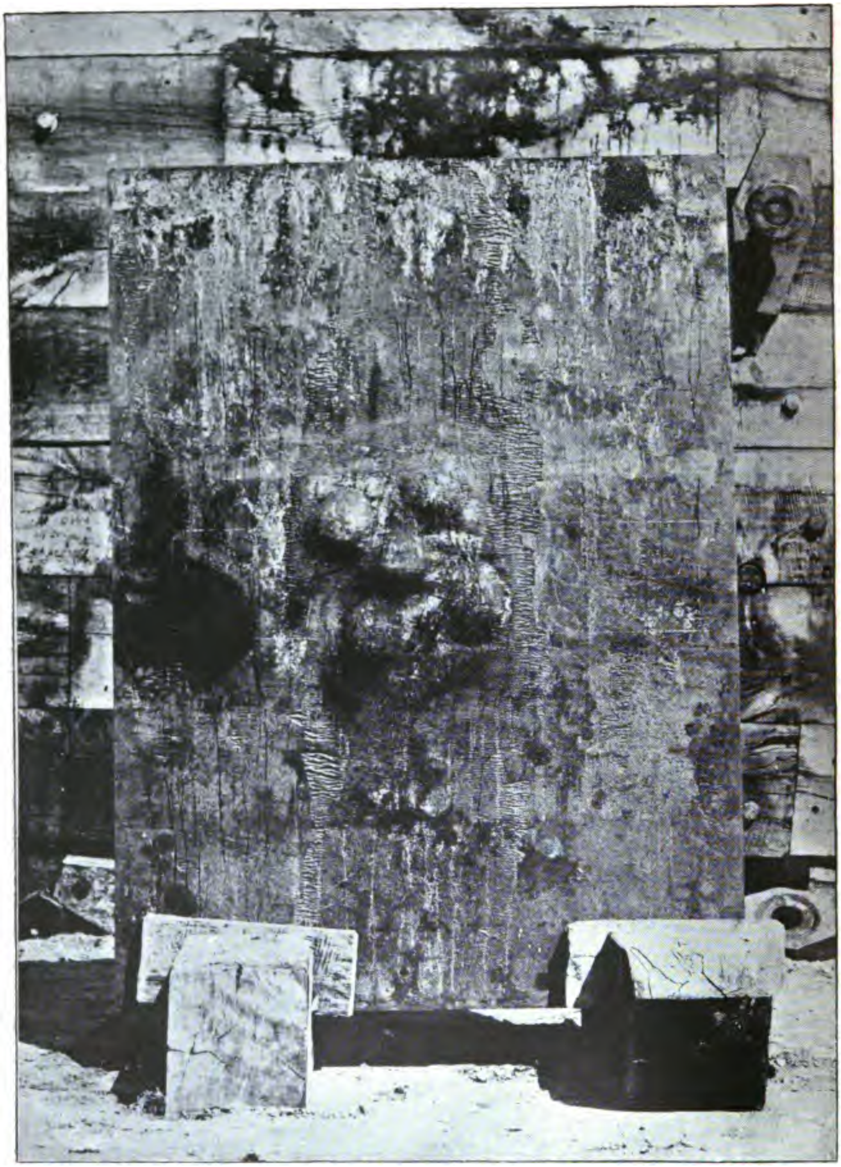


Fig. 3.—MARREL FRÈRES DECK PLATE. REAR VIEW.

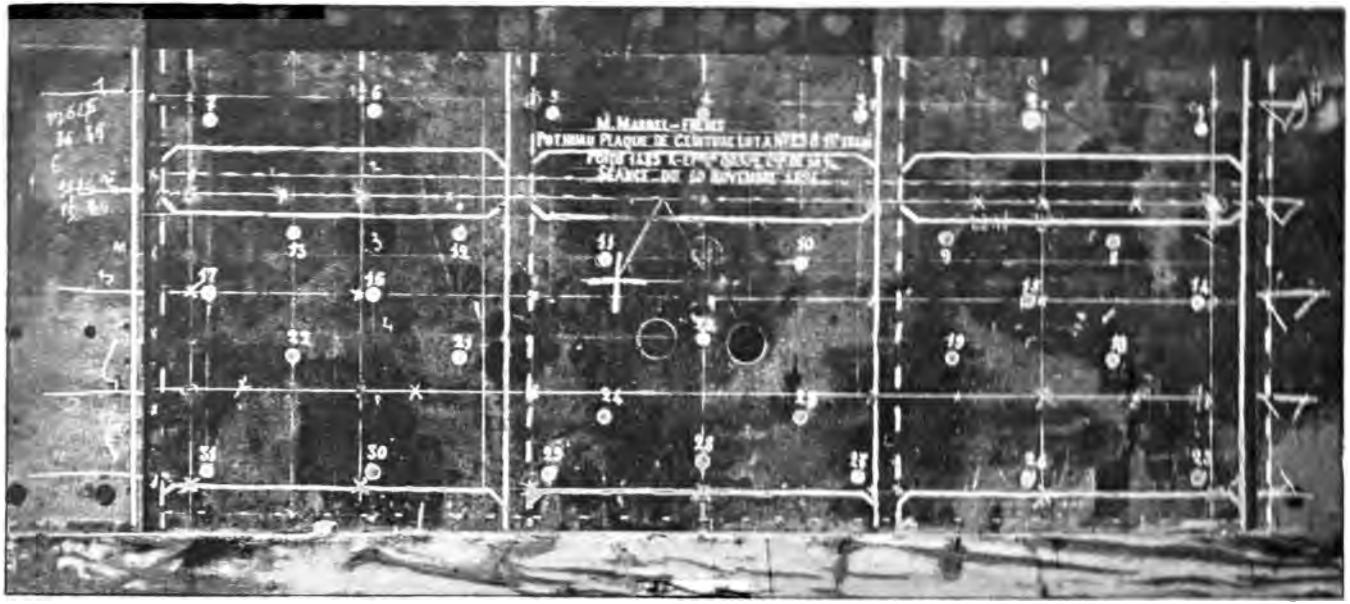
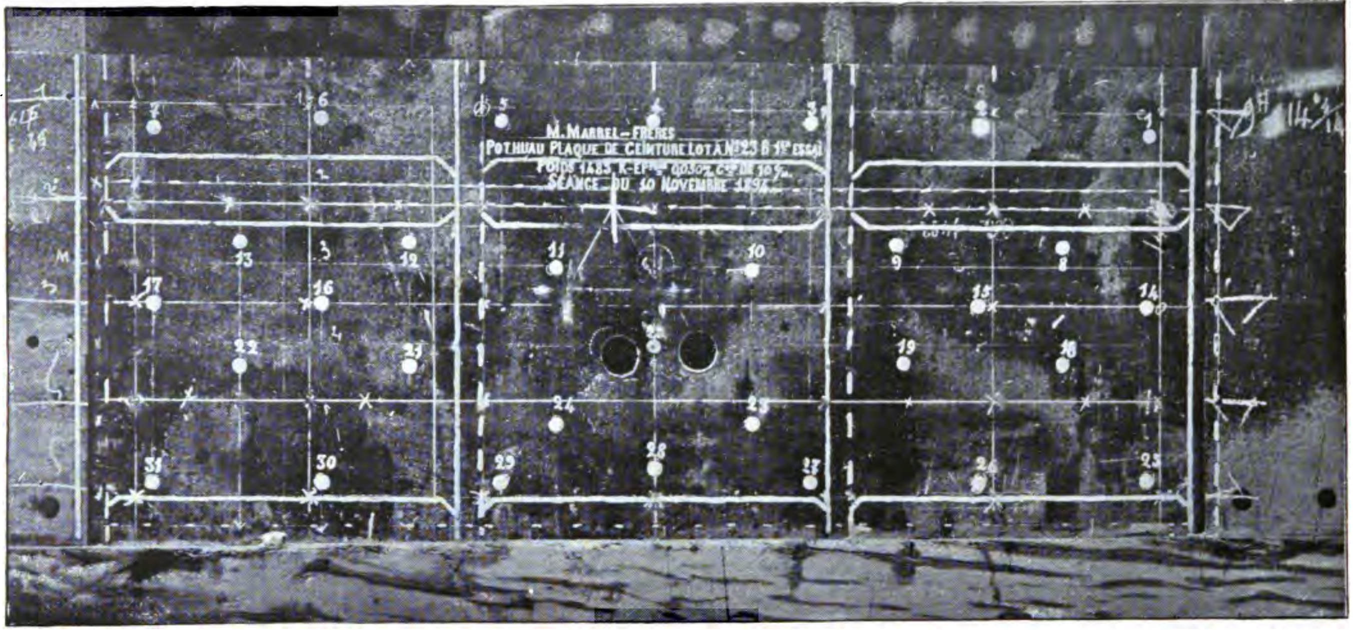


Fig. 4.-- First shot.

MARREL FRÈRES; POTHUAU F H. PLATE.


M. MARREL-FRÈRES
POTHUAU PLAQUE DE CEINTURE LOT A No. 23 B 1er ESSAI
POIDS 1485 K-EP 0.030 C DE 10%
SÉANCE DU 10 NOVEMBRE 1896
7
6
5
4
3
2
1
13
12
11
10
9
8
17
16
15
14
22
21
20
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26
25

Fig. 5.—Second shot.

MARREL FRÈRES; POTHUAU F. H. PLATE.

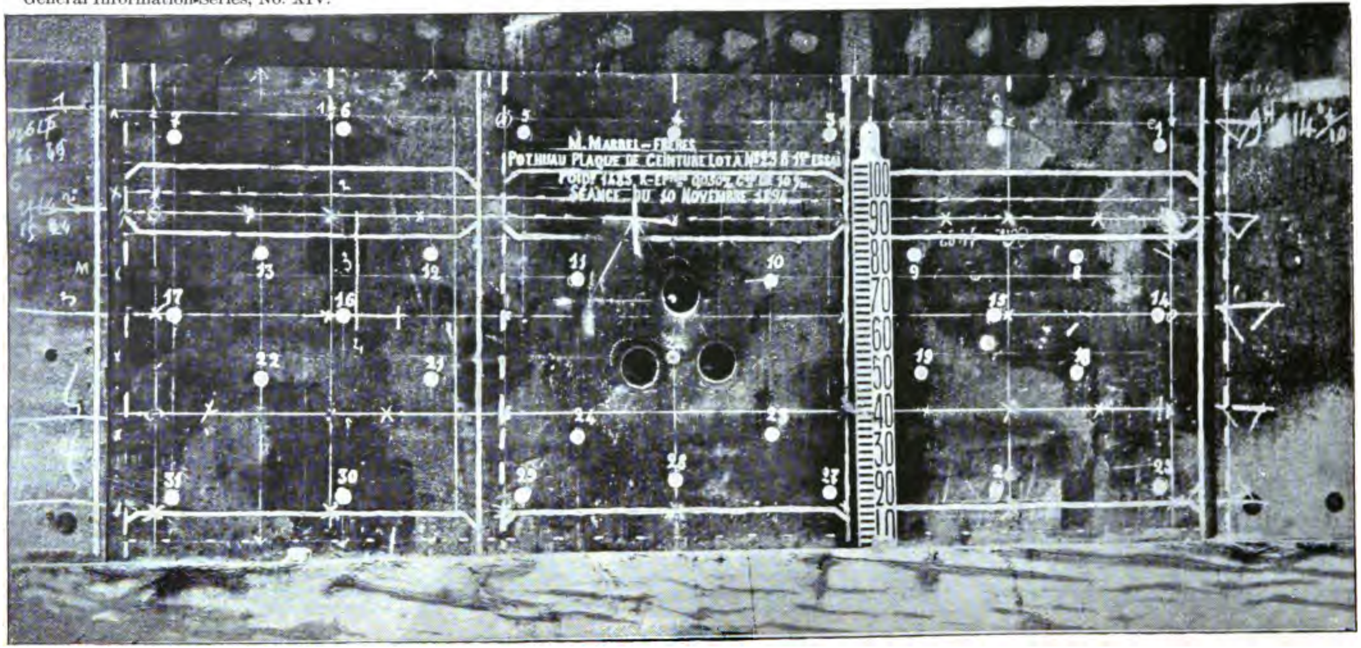
M. MARREL – FRÈRES
POTHUAU PLAQUE DE CEINTURE LOT A No 23 & 1er ESSAI
SÉANCE DU 10 NOVEMBRE 1894
100
90
80
70
60
50
40
30
20
10

Fig. 6.—Third shot.

MARREL FRÈRES; POTHUAU F. H. PLATE.
]

PLATE OF THE CHÂTILLON-COMMENTRY COMPANY.

The projectile broke up without complete perforation. The penetration was 11.8 inches. The point of the projectile touched the backing.

THE MARREL PLATE.

The projectile lodged in the plate and was unbroken, the base protruding 0.8 inch. Three radial cracks were developed extending to the three nearest edges. (*See* fig. 1.)

The results of these trials indicate the good quality of the French face-hardened plates. The higher grade of steel now made, combined with greater skill in surface hardening, brings the manufactures to a point where the plate stops a projectile traveling with an energy three times as great as is necessary to effect the perforation of an iron plate of the same thickness and almost twice that necessary to go through an ordinary steel plate.

Marrel Frères also submitted two varieties of light armor plate, photographs of which were obtained through the courtesy of that company. The first was a deck plate of mild steel, known as *acier extra doux.* Its dimensions were 6.6 by 4.9 feet by 2.95 inches. Five shots from a 164.7-millimeter (6.48-inch) gun were fired at it with a reduced velocity and 100-pound projectile. It withstood the attack without being perforated or cracked.

The other plate (*see* figs. 2 and 3) submitted by the same firm was tested in November, 1894. It was light face-hardened side armor, being of the following dimensions: 9.8 by 4.1 feet by 2 inches, weighing 14.6 tons. Three shots were fired from a 100-millimeter (3.93-inch) gun, with a projectile weighing 31 pounds. The striking velocity was 905 feet (*see* figs. 4, 5, and 6). These plates represent fairly the high qualities of French steel for different purposes.

Mr. Schneider, of the Creusot establishment, has just patented a method of cementation or carburization of armor plates by the use of gas. Two plates are placed in a very hot furnace, one above the other, with a space between them, the separation of the plates being accomplished by a frame of iron or steel placed between them. The joints between the frame and plates are made air and gas tight by the use of asbestus, or some other suitable material. The furnace is closed and the cementing, carburizing gas admitted. As the cementation of the plates progresses best at the point where the gas enters, it is admitted at a number of points. In order to supply the carbon equally over the whole surface of the plates the gas is supplied intermittently. The pipes supplying the gas and reaching into the furnace are inclosed in other pipes filled with water in order to cool the gas.

GERMANY.

On the 15th and 17th of December last armor trials were held at Meppen. The plates were manufactured by Krupp, and were of face-hardened nickel steel, by a process used by that firm. Plate No. 413 II was of the following dimensions: 8.2 by 4.6 feet by 5.75 inches, and showed on its surface some fine cracks developed in face hardening. Plate No. 425 B was 9.2 by 4.9 feet by 5.75 inches. In each case the backing consisted of two thicknesses of oak, each 11.8 inches, upheld by an iron framework 4.2 inches thick.

The guns used were a 15-centimeter (5.9-inch) and a 21-centimeter (8.3-inch). The former was 400 feet from the target, the projectile striking at an angle of 87 degrees. The latter was 397 feet from the target, the projectile striking exactly normal to the plane of the latter.

Shot No. 1 against plate No. 413 II.—The gun used was a 15-centimeter (5.9-inch), L/34, B. L. R.; projectile 112 pounds, which had a striking velocity of 1,560 feet, and 1,642 foot-tons of energy; the projectile was smashed to pieces, only penetrating the plate 0.55-inch. No cracks were developed. There was a slight bulge on rear face. (*See* figs. 7, 12, and 13.)

Shot No. 2.—The gun was the same, but the striking velocity was increased to 1,890 feet, with an energy of 2,778 foot-tons. The projectile perforated the plate, but was completely broken up. The fragments of the plate and projectile were driven through the backing. (*See* figs. 8, 12, and 13.)

Shot No. 3.—The gun and projectile were the same as in previous shots; striking velocity, 1,735 feet; energy, 2,268 foot-tons. The plate was not perforated. The projectile was smashed, the broken head remaining in the plate. It was bulged to the rear 1.97 inches, in which was a crack 1.57 inches deep. (*See* figs. 9, 12, and 13.)

Shot No. 4.—The gun was a 21-centimeter (8.27-inch) B. L. R., L/25, with a projectile of 209 pounds; striking velocity, 1,434 feet; energy, 2,980. The plate was not penetrated, and the projectile was demolished. The surface of the plate was broken up over an area a little greater in diameter than the projectile and to a depth of from 0.59 inch to 1.4 inches. Three fine radial cracks were developed. There was a bulge on the rear face 1 inch high and 13.8 inches in diameter. (*See* figs. 10, 12, and 13.)

Shot No. 5.—The gun was a 21-centimeter B. L. R., L/25; shot, 209 pounds; striking velocity, 1,644 feet; and energy of 3,923 foot-tons. The projectile perforated the plate and passed into the backing in fragments. The plate was not bulged, but pieces of the hard surface were flaked off. (*See* figs. 11, 12, and 13.)

Shot No. 1 against plate No. 425 B.—Gun used was a 15-centimeter (5.9-inch), L/34; projectile, 112 pounds, having a striking velocity of 1,560 feet and an energy of 1,642 foot-tons. The plate was penetrated

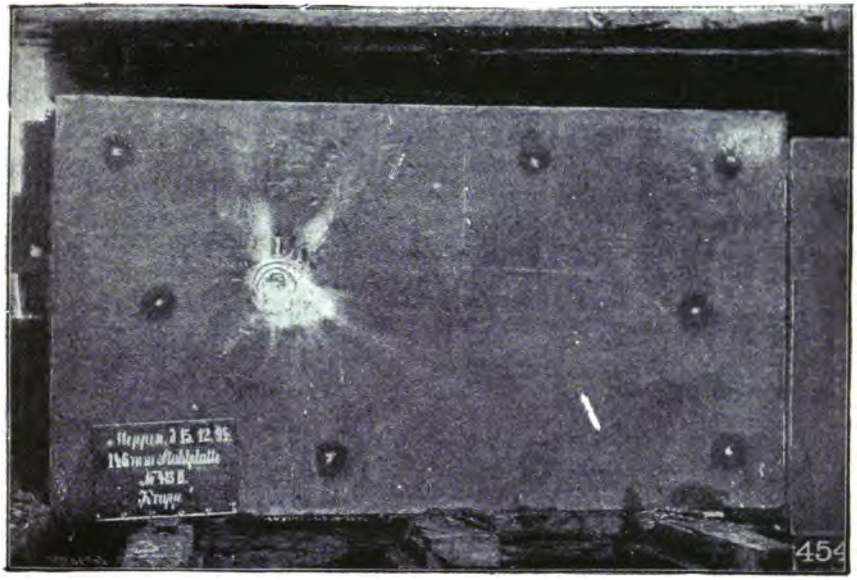

Fig. 7.

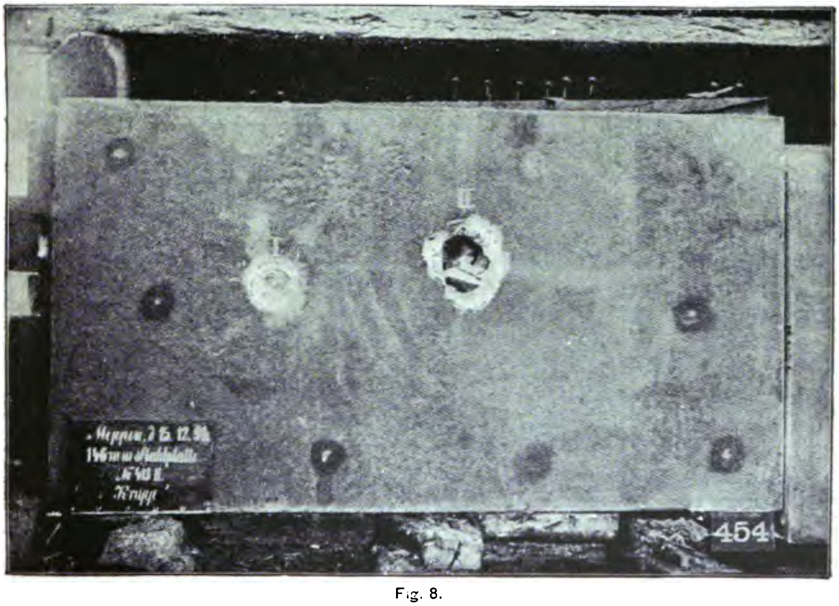

Fig. 8.

KRUPP F. H. NICKEL-STEEL PLATE NO. 413 II.

Marine Rundschau.

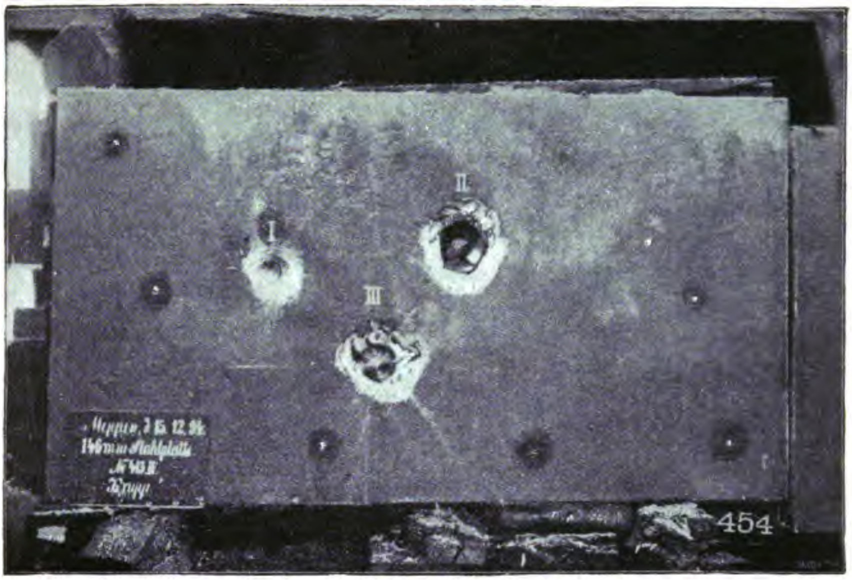

Fig. 9.

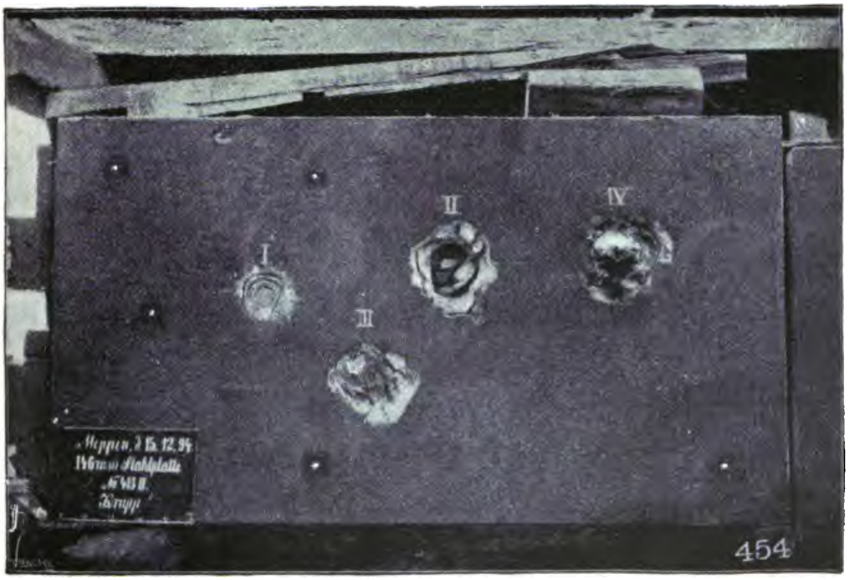

Fig. 10.

KRUPP F. H. NICKEL-STEEL PLATE NO. 413 II.

Marine Rundschau.

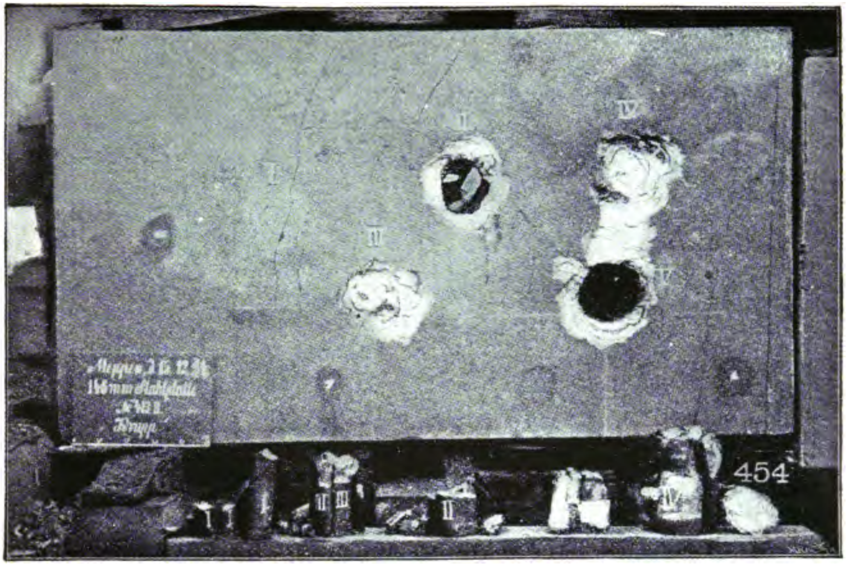

Fig. 11.

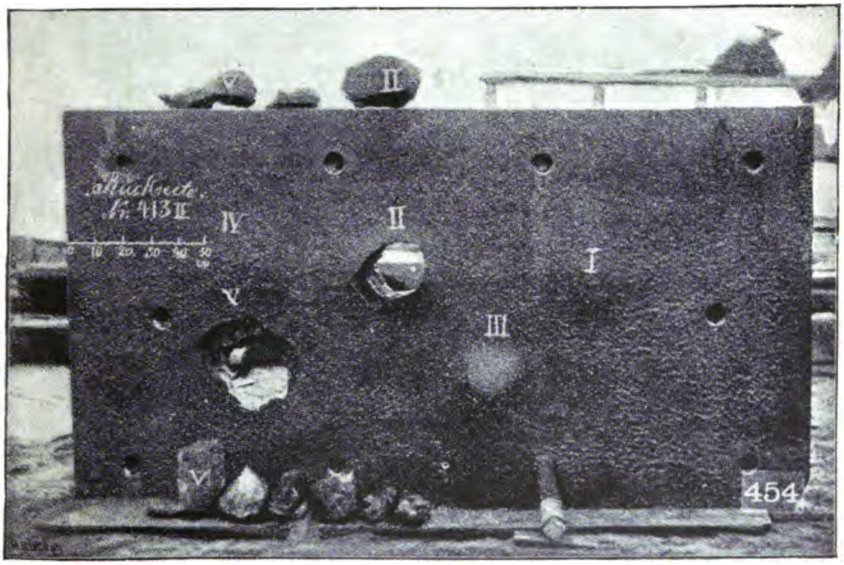

Fig. 12. – Rear view.

KRUPP F. H. NICKEL-STEEL PLATE

Marine Rundschau.

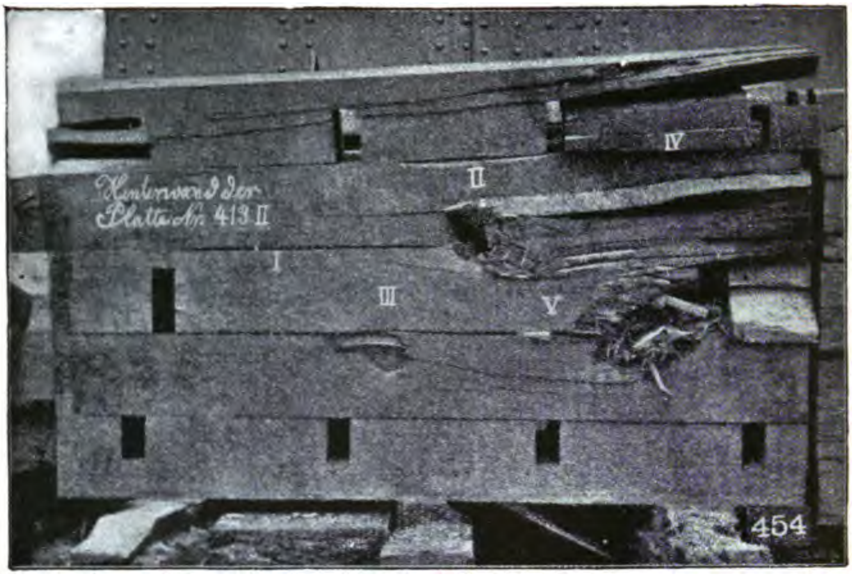

Fig. 13.—Backing.

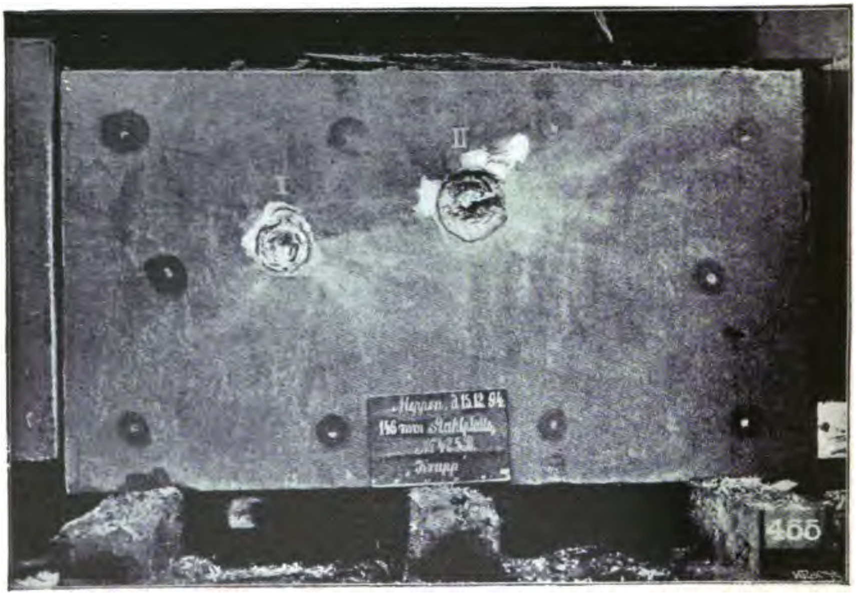

Fig. 14.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

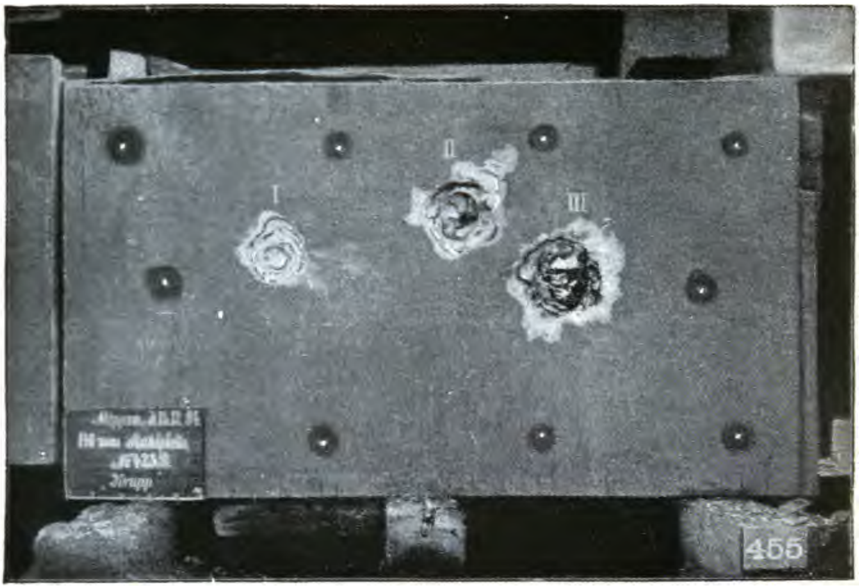

Fig. 15

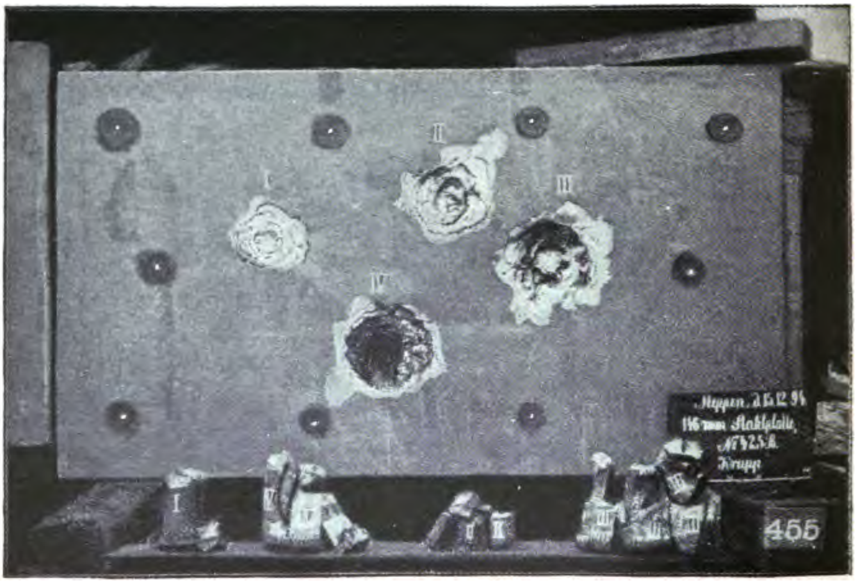

Fig. 16.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau

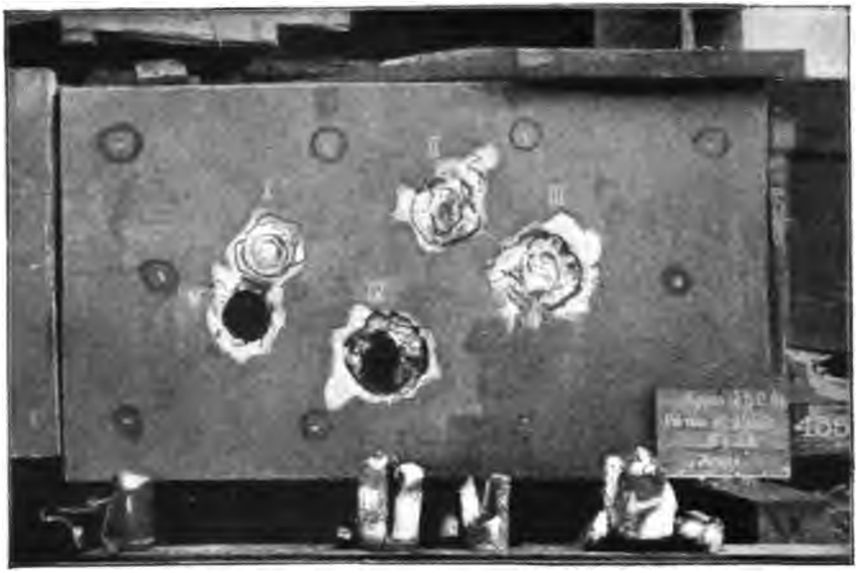

Fig. 17.

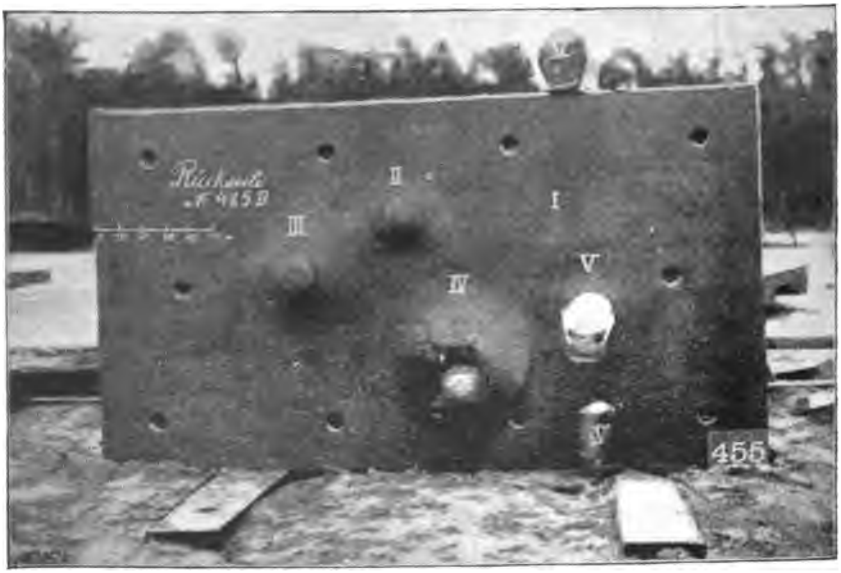

Fig. 18.—Rear view.

KRUPP F. H. NICKEL-STEEL PLATE

Marine Rundschau.

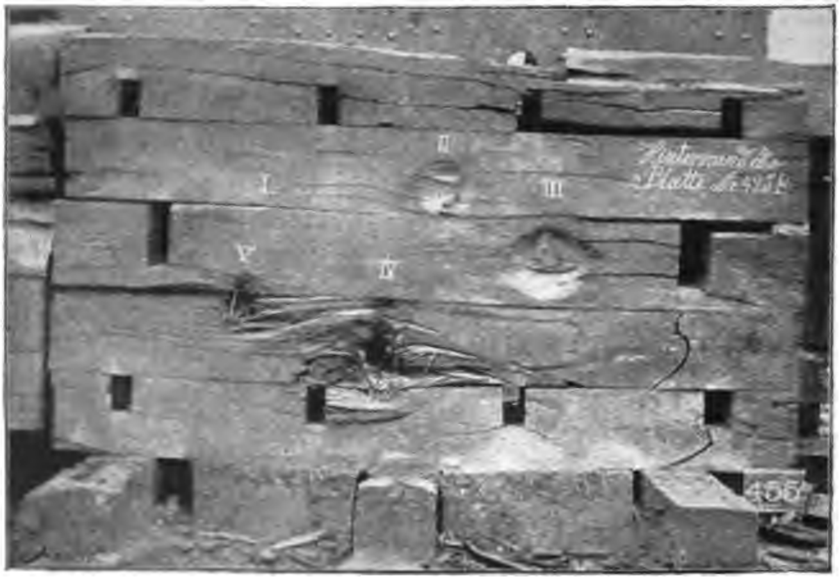

Fig. 19.—Backing.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau

to a depth of from 0.9 inch to 2.8 inches. No cracks were developed. (*See* figs. 14, 18, and 19.)

Shot No. 2.—Same gun was used, with a projectile of the same weight. The striking velocity was 1,890 feet, with an energy of 2,778 foot-tons. The plate was not perforated. The head of the projectile was destroyed, but the penetration could not be measured. The surface of the plate about point of impact was flaked off. The plate was bulged to the rear to a height of 1.7 inches and 17.7 inches in diameter; in this was a deep vertical crack. The backing was scored to a corresponding depth. (*See* figs. 14, 18, and 19.)

Shot No. 3.—The gun was a 21-centimeter (8.27-inch) B. L. R., L/25, with a projectile of 210 pounds. The striking velocity was 1,562 feet, representing an energy of 3,262 foot-tons. The plate was not perforated. The projectile was broken up into small fragments; a portion of the head was welded into the plate; around its edge pieces of the hard surface were flaked off. The plate was bulged to a height of 3.1 inches, in which there was a deep vertical crack. A corresponding indentation was made in the backing. (*See* figs. 15, 18, and 19.)

Shot No. 4.—The gun used was a 21-centimeter (8.27-inch), L/25; projectile, 210 pounds; striking velocity, 1,627 feet; 3,860 foot-tons energy. The plate and backing were perforated. The head of the projectile was smashed; the remainder was recovered considerably deformed. The plate was bulged to the rear. (*See* figs. 16, 18, and 19.)

Shot No. 5.—The gun used in this attack was a 15-centimeter (5.9-inch) B. L. R., L/34, projectile weighing 112 pounds; striking velocity, 2,022 feet; energy, 3,170 foot-tons. The shot perforated the plate, punching out a section about equal in diameter to the projectile, and both passed into the second layer of the backing. Some hair cracks were developed between shots 2 and impact. (*See* figs. 17, 18, and 19.)

Another firing trial of Krupp's surface-hardened nickel-steel plates took place March 15 and 16, 1895. Two plates, manufactured as one and cut apart, were tested. One measured 6.6 by 5.9 feet by 11.8 inches, the other 9.8 by 6.2 feet by 11.8 inches. Both were secured to a backing consisting of four thicknesses of timber, each 10 inches square, and a wrought-iron bulkhead. The smaller plate was fastened to this by five 3.1-inch bolts, the larger one by eight of the same size.

Shot No. 1, against smaller plate.—From a Krupp 28-centimeter (11-inch) L/25 B. L. R. The projectile weighed 520 pounds, the striking velocity was 1,812 feet, and energy 11,830 foot-tons. The projectile was completely broken up. The head penetrated 5.3 inches, remaining in the plate. The surface of the plate was broken up over an area 17.7 inches in diameter, and was flaked off to a depth of 0.8 inch. (*See* figs. 20, 23, and 24.)

Shot No. 2.—Delivered from a 21-centimeter (8.27-inch) B. L. R., L/33, the projectile weighing 305 pounds. The striking velocity was 2,172 feet, with an energy of 10,000 foot-tons. The plate was not perforated nor cracked. The penetration was not measurable. The projectile was smashed. The broken point remained in the plate, and the surface was broken over an area 19.7 by 17.7 inches. The plate was slightly bulged. (*See* figs. 21, 23, and 24.)

Shot No. 3.—The same gun and projectile were used, but the velocity was increased to 2,238 feet, the corresponding energy being 10,590 foot-tons. The plate was not perforated. The projectile was smashed to pieces, the point remaining in the plate. The penetration was not measurable. The surface of the plate was broken away over an area of 17.5 inches in diameter and to a depth of 0.8 inch. A crack extended from the place of impact to the lower edge of the plate, 3.1 inches deep. There was also a small radial crack extending from shot mark No. 1. The bulge on rear face was of the same size as those made by shots Nos. 1 and 2. The timbers of the backing were considerably crushed in wake of this shot and two bolts were wrenched away and driven into the backing. (*See* figs. 22, 23, and 24.)

The larger plate, which was marked 432ᵘ, was attacked by a 30.5-centimeter (10-inch) gun, L/28. Three shots were fired with an increasing velocity.

Shot No. 1.—The projectile weighed 716 pounds and had a velocity of 1,753 feet and an energy of 15,260 foot-tons. The plate was not perforated nor cracked. The projectile was broken up, the point remaining in the plate, effecting a penetration of 3.5 inches. The surface of the plate was broken away over an area of 26 inches in diameter and to a depth of 0.8 inch. The rear of the plate was bulged, the diameter of which was 19.7 inches; its height was 1 inch. In the backing was a corresponding depression. (*See* figs. 25, 28, and 29.)

Shot No. 2.—This was delivered with the same weight of projectile, but the velocity was 1,890 feet with the corresponding energy of 17,468 foot-tons. The plate was not perforated, nor were there any cracks. The projectile was completely smashed. The head remained sticking in the plate, having penetrated 7.1 inches. The surface was broken away over an area of 23.5 by 27.5 inches and to a depth of 1.6 inches. The rear face of the plate was bulged. This spot was 13.7 inches in diameter and 2.4 inches high. The corresponding depression in the backing was 2.3 inches deep by 13.7 inches in diameter. (*See* figs. 26, 28, and 29.)

Shot No. 3.—The blow was delivered by a projectile weighing 712 pounds, with a velocity of 1,993 feet and an energy of 19,600 foot-tons. The plate was not perforated. The projectile was smashed to pieces, the broken point remaining in the plate. The penetration was not measurable. The surface of the plate was broken off over an area of 33.5 by 27.5 inches and to a depth of 2.4 inches. A fine, radial crack was developed, extending toward impact No. 1, and another was opened which extended to a depth of 3.1 inches. The bulge was 2.6 inches high and 23.5 inches in diameter. The backing in wake of this shot splintered. (*See* figs. 27, 28, 29, and 30.)

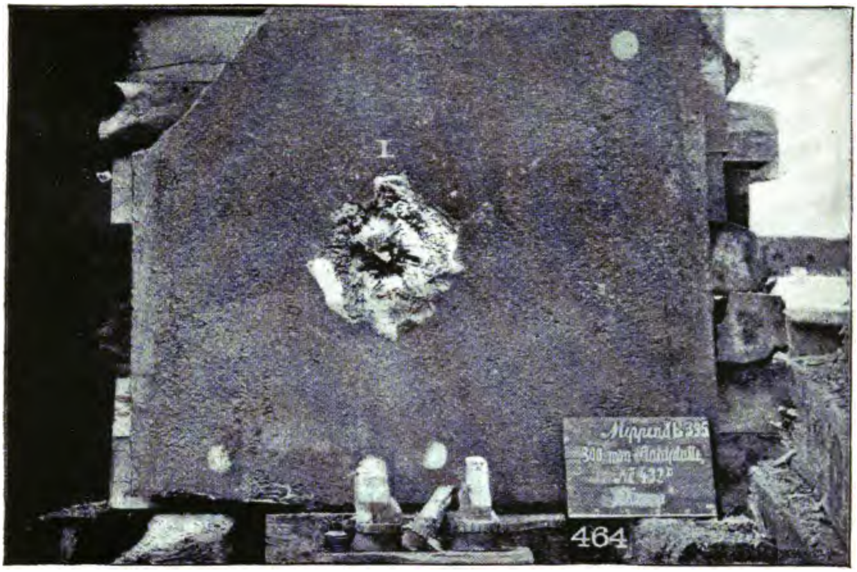

Fig. 20.

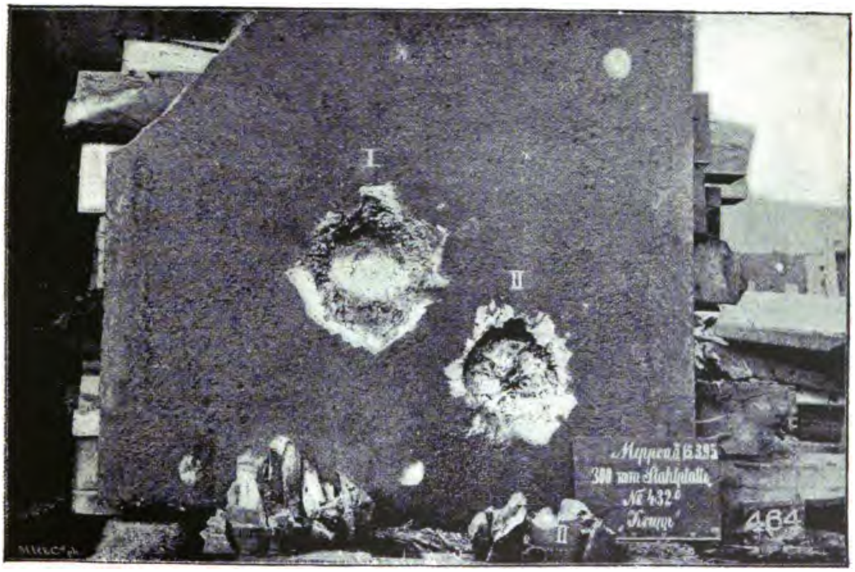

Fig. 21.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

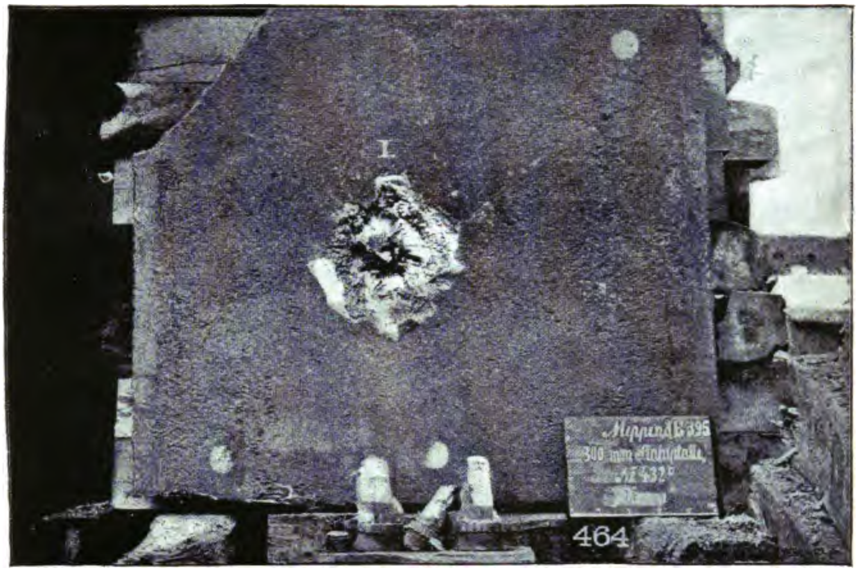

Fig. 20.

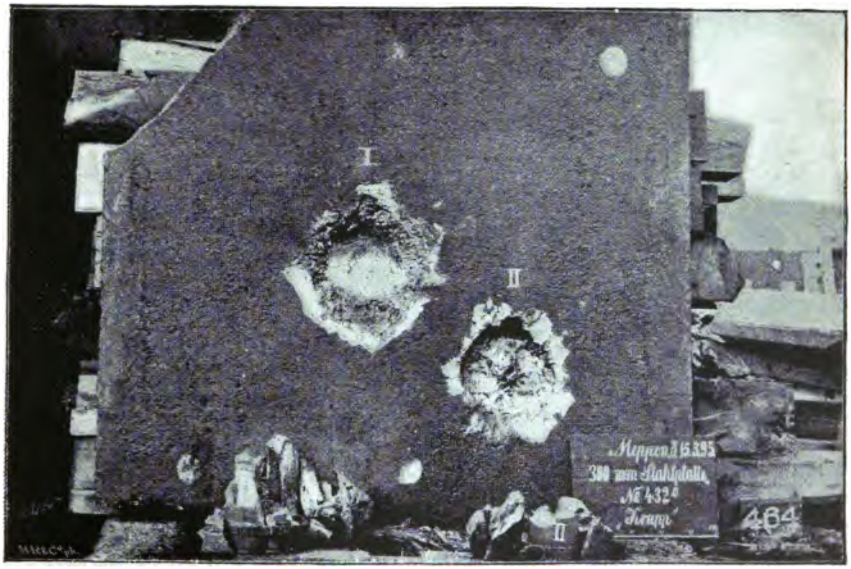

Fig. 21.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

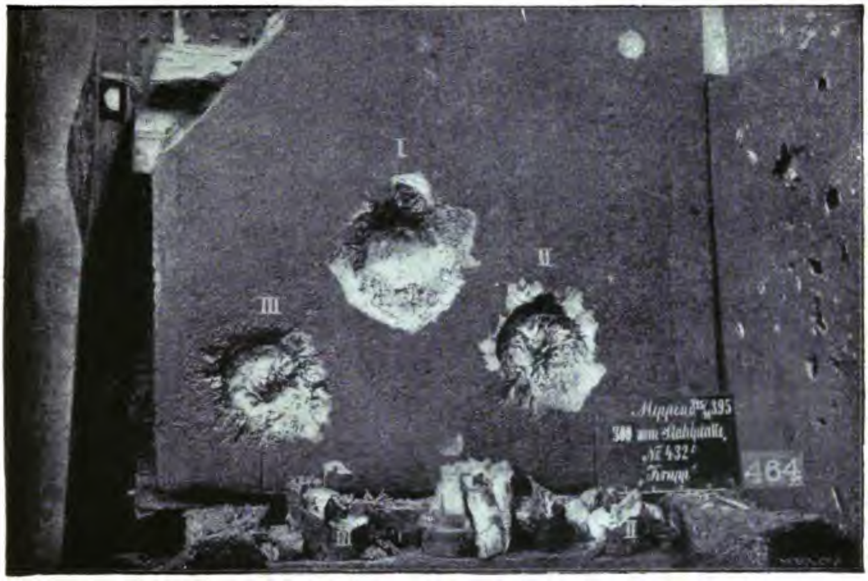

Fig. 22.

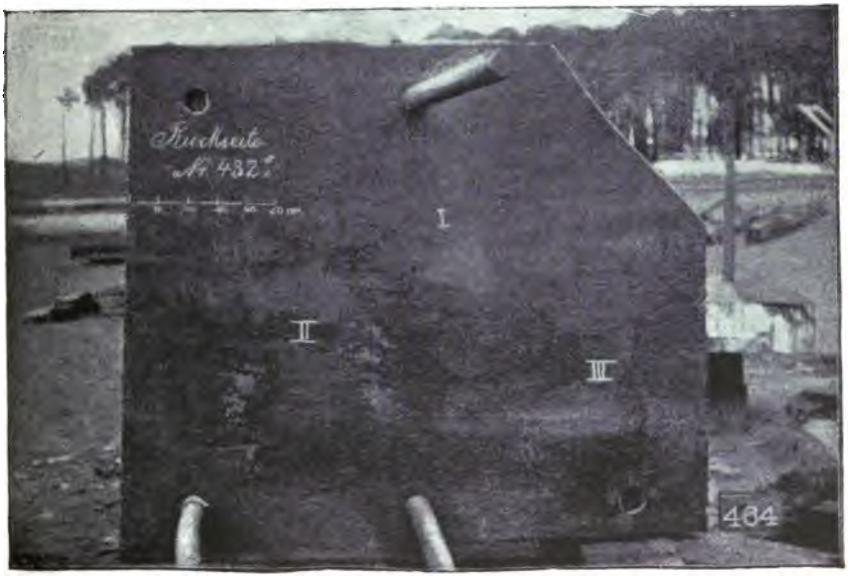

Fig. 23.—Rear view.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

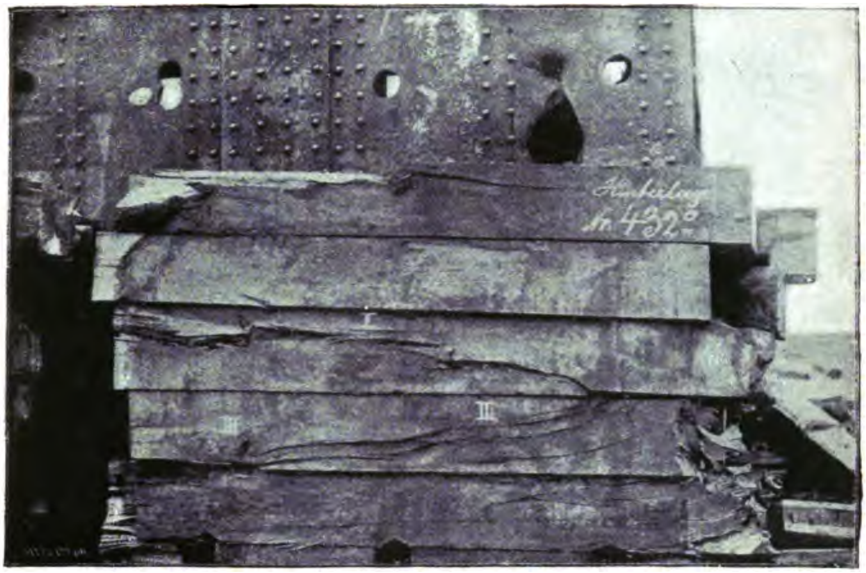

Fig. 24.—View of backing.

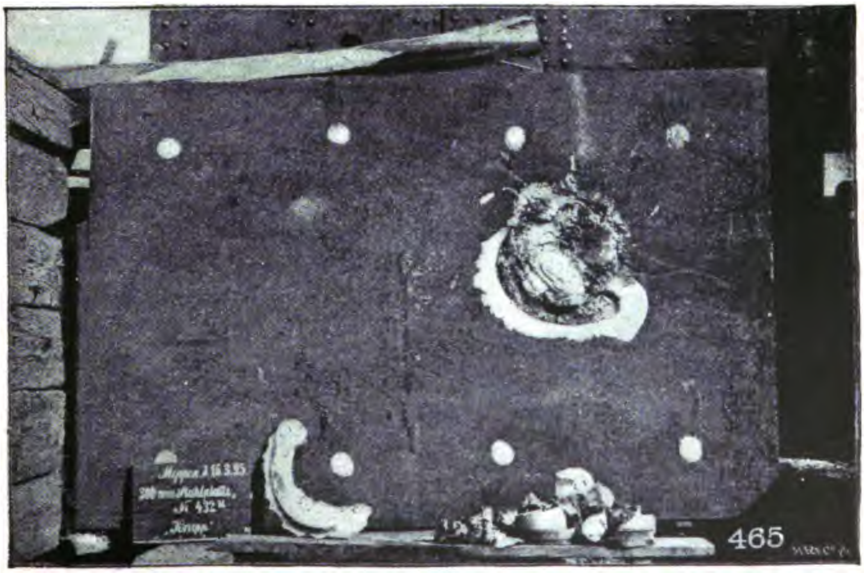

Fig. 25.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

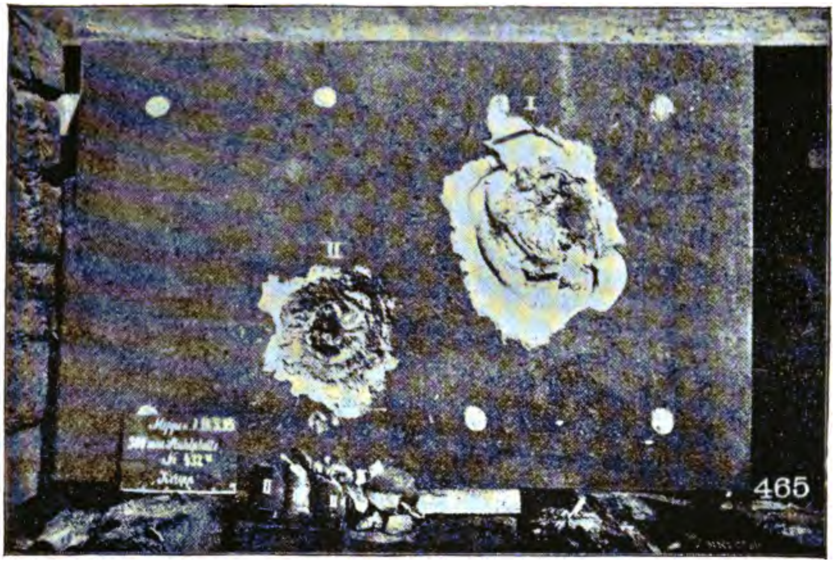

Fig. 26.

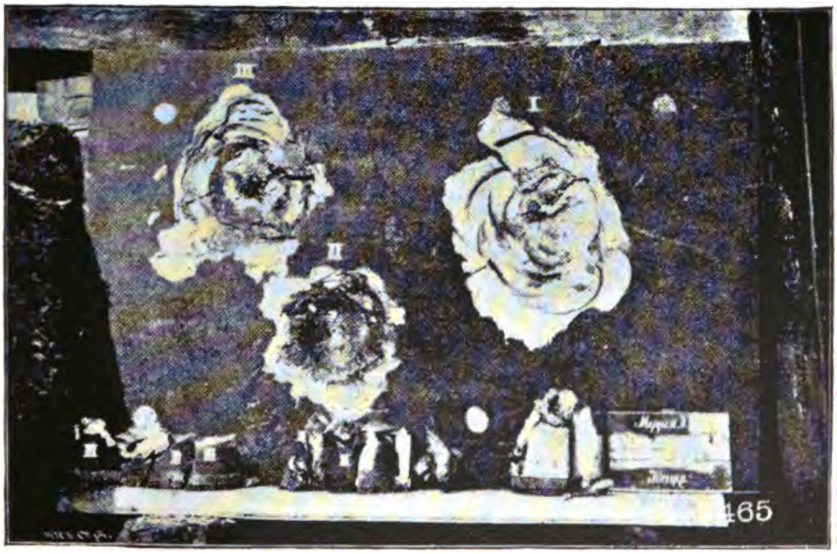

Fig. 27.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

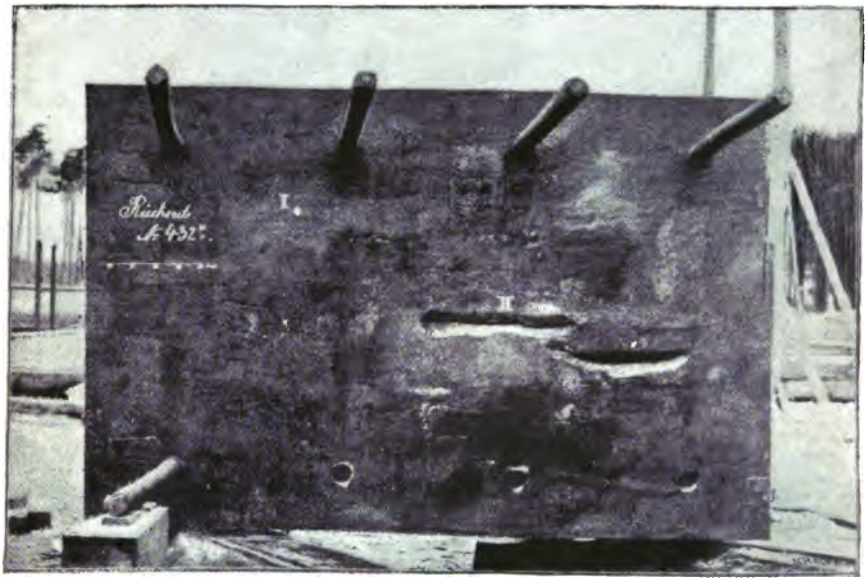

Fig. 28.—Rear view.

KRUPP F. H. NICKEL-STEEL PLATE.

Marine Rundschau.

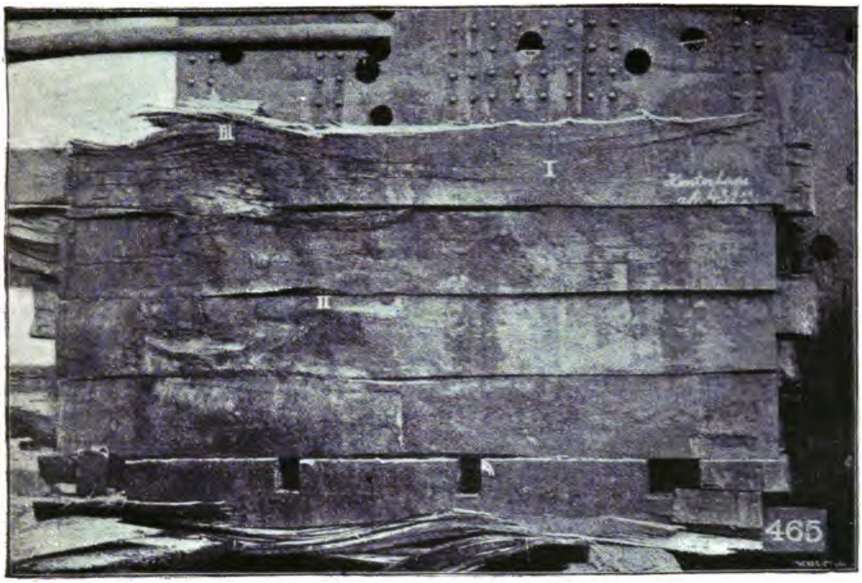

Fig. 29.

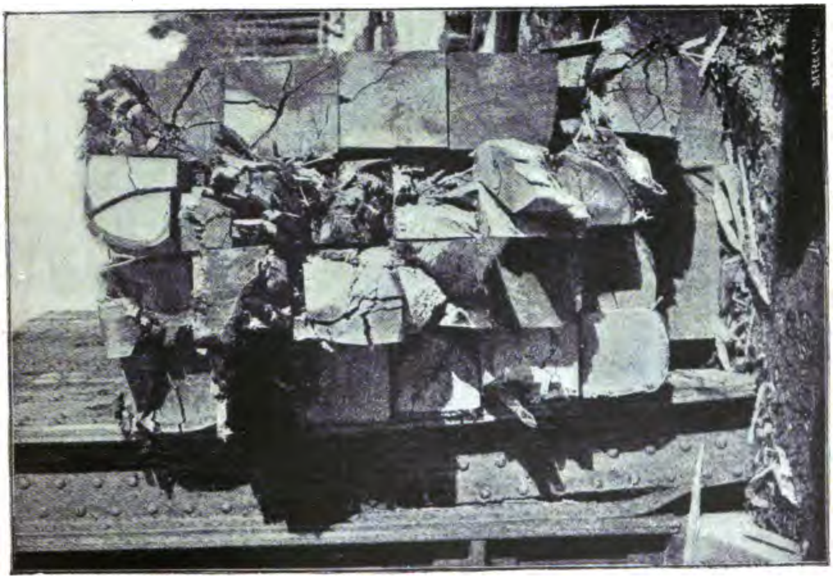

Fig. 30.

FRONT AND SIDE VIEWS OF BACKING.

Marine Rundschau.

GREAT BRITAIN.

In the explanatory statement accompanying the navy estimate for 1895–96 the first lord of the Admiralty says:

> During the year various experimental armor plates have been submitted by manufacturers for purposes of test. None of these, however, have shown qualities equal to those possessed by the Harveyed steel armor mentioned in my statement of last year.* Consequently armor of that description has been maintained in use, and the demands made upon the manufacturers during the past year have been very considerable. The manufacturing firms have shown, as on previous occasions, their readiness to do their utmost to meet the requirements of the Admiralty. It is anticipated that there will be no difficulty in carrying out the orders placed under the new program, the area of supply for armor having been somewhat enlarged.

HARVEYED 6-INCH STEEL ARMOR PLATE, TESTED FEBRUARY 12, 1895.

A trial of Harveyed steel armor plate manufactured by Messrs. John Brown & Co., Sheffield, took place on board the *Nettle* at Portsmouth. The plate was selected from a batch forming the armor for one of the barbettes of the *Magnificent*, building at Chatham, and were of the following dimensions: 8 by 6 feet by 6 inches. Four 6-inch Holtzer projectiles were fired against the plate with the velocities of 1,507, 1,815, 1,960, and 1,815 foot-seconds, respectively. All the projectiles were completely broken up; the fragments of the third shot alone succeeded in just perforating the plate. The penetration in the other cases was estimated at from 2 to 4 inches. The trial was considered highly satisfactory.

NETHERLANDS.

A trial of nickel-steel armor plate manufactured by the Compagnie des Hauts-Fourneaux, Forges et Aciéries de la Marine et de Chemins de Fer was held at their proving grounds December 10 and 11, 1894. They represented armor to be furnished for the Dutch war ships of the *Kortenær* and *Piet Hein* types (p. 59, No. XIII). The test plates were secured to a wooden backing 40 centimeters (15.7 inches) thick, behind which was an iron framework about 2 inches in thickness. Plate No. 1 was secured with 8 bolts. Its dimensions were 6.9 by 6 feet by 5.9 inches. Three shots were to be fired from a 6-inch gun at points 2.5 calibers from each other, with a velocity of not less than 1,532 feet. The projectiles used were of chrome steel 39.6 centimeters (15.6 inches) in length and weighed 90 pounds. The results are given in Table 1 and fig. 31.

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* Page 138, No. XIII.

Table 1.

No. of shot.	Weight of charge.	Muzzle velocity.	Striking velocity.	Result.	Remarks.
	Pounds.	*Foot-secs.*	*Foot-secs.*		
1..........	19.8	1,532	1,522	The projectile stuck in the plate.	The base of the projectile extended 4.45 inches to the rear.
2..........	19.8	1,529	1,522	The projectile perforated the plate and entered 2.8 inches into the backing.	Surface of the plate was broken in fine cracks above place of impact. The projectile rebounded 59 feet.
3..........	19.8	1,542	1,532	The projectile stuck in the plate.	The base of the projectile extended 4.72 inches to the rear.

The next plate tested, made for the *Piet Hein*, was of the following dimensions: 5.6 by 5 feet by 3.9 inches, secured to a backing of the same kind as that used with plate No. 1. The projectile was of chrome steel fired from a 9.45 centimeter (3.72-inch) gun. It weighed 25 pounds, and was 9.8 inches in length. The contract striking velocity was 1,509 feet, and four shots were to be fired at this plate, three in the same manner as at plate No. 1. (*See* fig. 32 and Table 2.)

Table 2.

No. of shot.	Weight of charge.	Muzzle velocity.	Striking velocity.	Result.	Bulge.		Remarks.
					Height.	Diameter.	
	Pounds.	*Foot-secs.*	*Foot-secs.*		*Inches.*	*Inches.*	
1......	5.1	1,532	1,522	Plate was penetrated. Projectile entered backing 0.8 inch.	0.8	5	At the back of each hole the plate was slightly torn.
2......	5.1	1,522	1,512	Plate was penetrated. Projectile entered backing 0.4 inch.	.8	5	All three projectiles uninjured and rebounded from 30 to 50 feet.
3......	5.1	1,532	1,519	.....do................	.8	5	
4......	5.1	....	1,591	Plate was penetrated. Projectile entered backing 1.2 inches.	.8	5	Result of fourth shot as noted above, except metal of the plate was raised in a rim around the point of impact; shot rebounded.

The third plate was one rolled for the *Evertsen*, and tested February 15, 1895. Its dimensions were 6 by 5 feet by 5.9 inches. It was held to a backing of the same thickness by means of 8 bolts, which were also secured to a steel framework 0.5 inch thick. The gun used was a

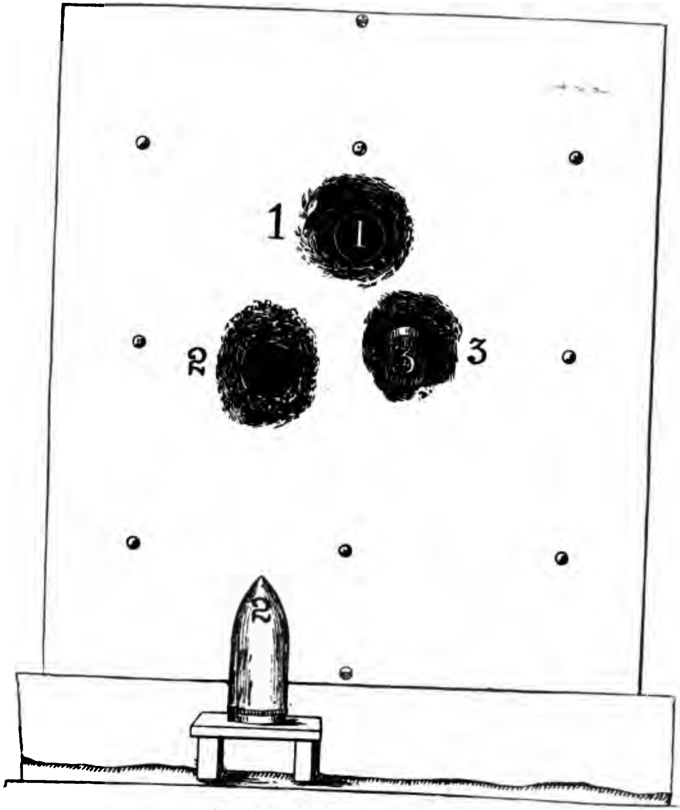


Fig. 31.—ST. CHAMOND PLATE.
Dimensions, 6.9 by 6 feet by 5.9 inches.

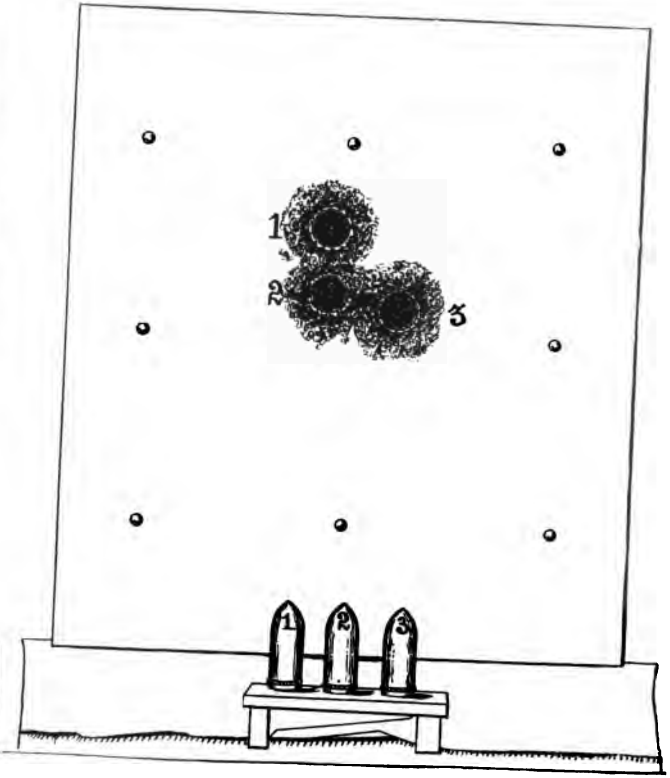


Fig. 32.—ST. CHAMOND PLATE.
Dimensions, 5.6 by 5 feet by 3.9 inches.

Marineblad.

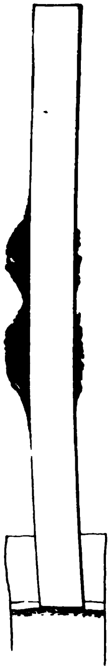


Fig. 33.

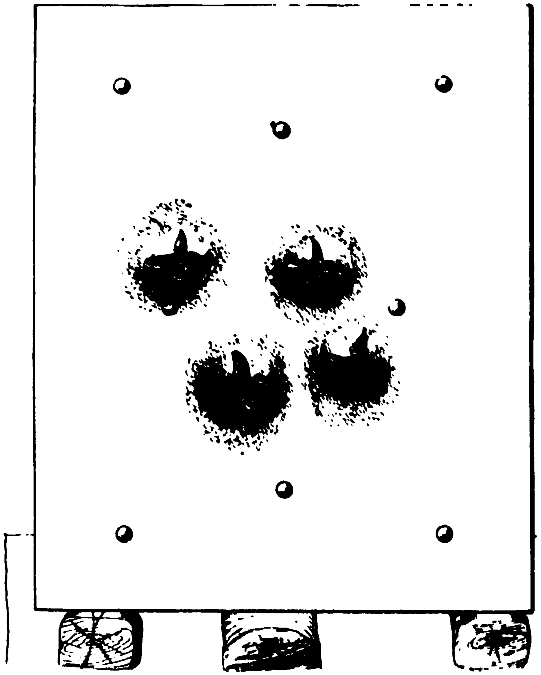


Fig. 34. Back.

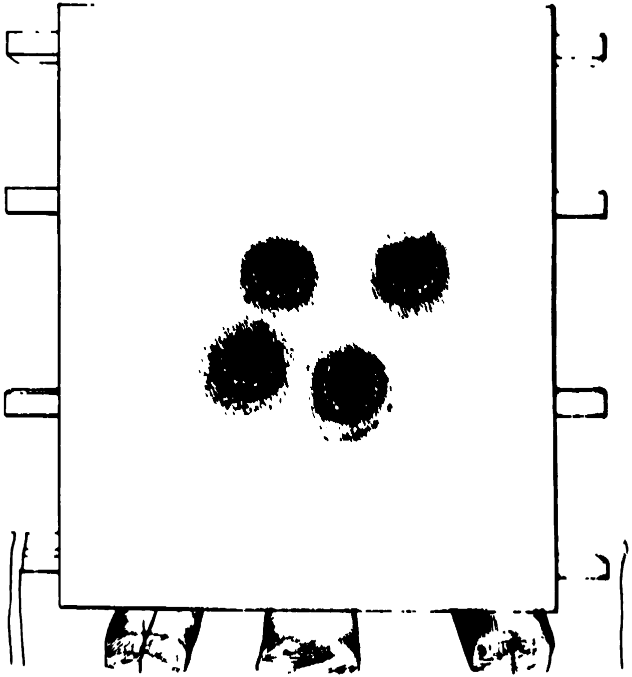


Fig. 35. Face.

ST. CHAMOND PLATE

Dimensions, 6 by 5 feet by 5.9 inches

[illegible]

6-inch, firing a chrome-steel projectile weighing 90 pounds. It was 15.6 inches in length. The contract called for a striking velocity of 1,526 feet. (*See* figs. 33, 34, and 35 and Table 3.)

Table 3.

No. of shot.	Weight of charge.	Muzzle velocity.	Striking velocity.	Result.	Bulge.		Remarks.
					Height.	Diameter.	
	Pounds.	*Foot-secs.*	*Foot-secs.*		*Inches.*	*Inches.*	
1	19.8	1,509	1,503	Projectile penetrated plate and entered backing 3.1 inches.	1.4	8.2	Projectile rebounded 150 feet.
2	20	1,509	1,503	Penetrated plate and entered backing 3.5 inches.	1.5	8.2	Projectile rebounded 150 feet. It was here found that an error had been made in measuring the velocities. Steps were taken to prevent its recurrence.
3	19.8	1,539	1,532	.....do	1.5	8.2	Projectile rebounded 65 feet. A fourth shot was fired to verify the velocity of No. 3.
4	19.8	1,540	1,532	.....do	1.5	8.2	Projectile rebounded 100 feet.

NOTE.—The temperature of the air was 18° F. All projectiles were uninjured; the last one fired had been used once before, on the 11th of December.

On March 21, 1895, a plate for the turret of the *Kortenaer* was tested. Its dimensions were as follows: 7 by 6 feet by 9.45 inches. The projectile used was of the same kind as that used at the trials of December 10 and 11, 1894, and February 15, 1895. The gun employed was a 6-inch B. L. R. The backing was 23 centimeters (9.5 inches) thick, secured by means of 8 bolts to an iron framework. The striking velocity required by contract was 2,119 feet. The wires of the chronograph were placed 115 feet from the muzzle of the gun. The shots required to be delivered were three in number. The mean muzzle velocity was 2,129 feet. (*See* figs. 36 and 37 and Table 4.)

Table 4.

No. of shot	Weight of charge.	Muzzle velocity.	Striking velocity.	Result.	Bulge. Height.	Bulge. Diameter.	Remarks.
	Pounds	*Foot-secs.*	*Foot-secs.*		*Inches.*	*Inches.*	
1	45.6	2,123	2,112	Projectile lodged in plate.	1.77	9.65	Base of projectile even with surface of plate. The powder charge was slightly increased.
2	46.1	2,130	2,120	do	1.77	9.65	Same result, except that the base of projectile was sunk 1.5 inches below surface of plate.
3	46.1	2,156	2,142	do	1.77	9.65	Base of projectile 3.9 inches below surface of plate.
4	49.6	2,238	2,228	Plate was perforated.	1.77	9.65	Projectile buried itself in the backing. This one had been used twice before. All were uninjured.

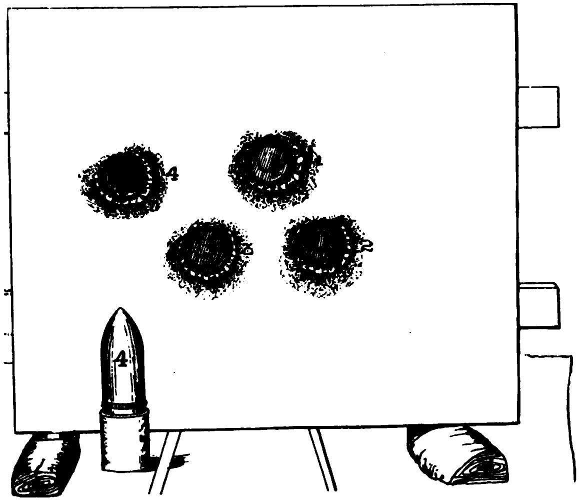


Fig. 36.—Front.

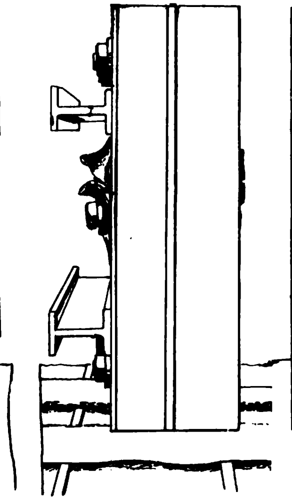


Fig. 36*a*.

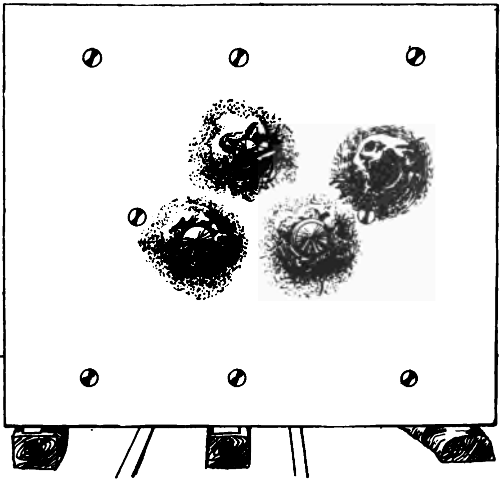


Fig. 37.—Back.

ST. CHAMOND PLATE.

Dimensions, 7 by 6 feet by 9.45 inches.

Marineblad.

III.

NOTES ON SMALL ARMS.

By Lieut. LINCOLN KARMANY, United States Marine Corps,

Staff Intelligence Officer.

During the past year European powers have continued experiments with small calibers, with the result that a 5-millimeter (.197-inch) rifle is considered practicable, and even smaller calibers will be tried.

Extensive experiments were recently carried out in England by a committee of officers to determine ballistic data concerning the .303-inch Lee-Metford and the .256-inch Mannlicher rifles. The ammunition used was cordite, and the initial velocities 2,000 foot-seconds for the former and 2,300 to 2,400 foot-seconds for the latter. The following are some of the conclusions arrived at:

Brick walls built for defense should be at least 9 inches thick and have fine joints set in cement. Inferior brick walls with large joints are not entirely bullet proof even up to 14 inches in thickness, at the shorter ranges. Two rows of English bricks, breaking joints, and each presenting a thickness of 4.5 inches, if kept together between boards, will stop any bullets at all ranges. A 24-inch sun-dried brick wall appears to be quite proof a short time after setting. Fresh (green) mud walls would require to be at least from 4 to 5 feet in thickness to stop bullets at any range. With low steel a thickness of 0.44 inch is required for safety. Sap shields should be of 0.25-inch hardened steel to be impenetrable by the Mannlicher bullet. At 500 yards, however, a plate of slightly less than 0.1 inch, hardened, resisted both this and the Lee-Metford bullets. Green timber has, against the sheathed bullet, only about the same resistance as dry, and it is therefore clear that at ranges much under 1,000 yards, timber balks and standing trees will not generally afford much protection except against ricochets. The bullets penetrate nearly 3.5 feet into clay, and this falls off but little up to 2,000 yards.

Penetration into sand is inconsiderable, owing to deformation or breaking up of the bullet; that of the Lee-Metford into sand between boards is less than 18 inches at any range, while that of the Mannlicher is even less. A thickness of 3 inches of large flint shingle between boards smashed up and stopped all bullets, even at the shortest ranges, but a greater thickness of finer shingle was required. Stockades of planks with sand, shingle, or dry brick cores will now replace the heavy timber balks formerly used. In the absence of shingle a few inches of the macadam of roads will supply the necessary core. Not much alteration is required in sand parapets to resist musketry, but damp clay parapets must be considerably thicker, and those of loam must also be increased, unless a hard core is inserted. A navy coal sack filled with coal and 12 inches thick is impenetrable.

The greatest observed range obtained was 3,760 yards with the Lee-Metford. It seems that 4,000 yards is beyond the extreme range of this piece under ordinary circumstances, but the bullet will kill up to the extreme range.

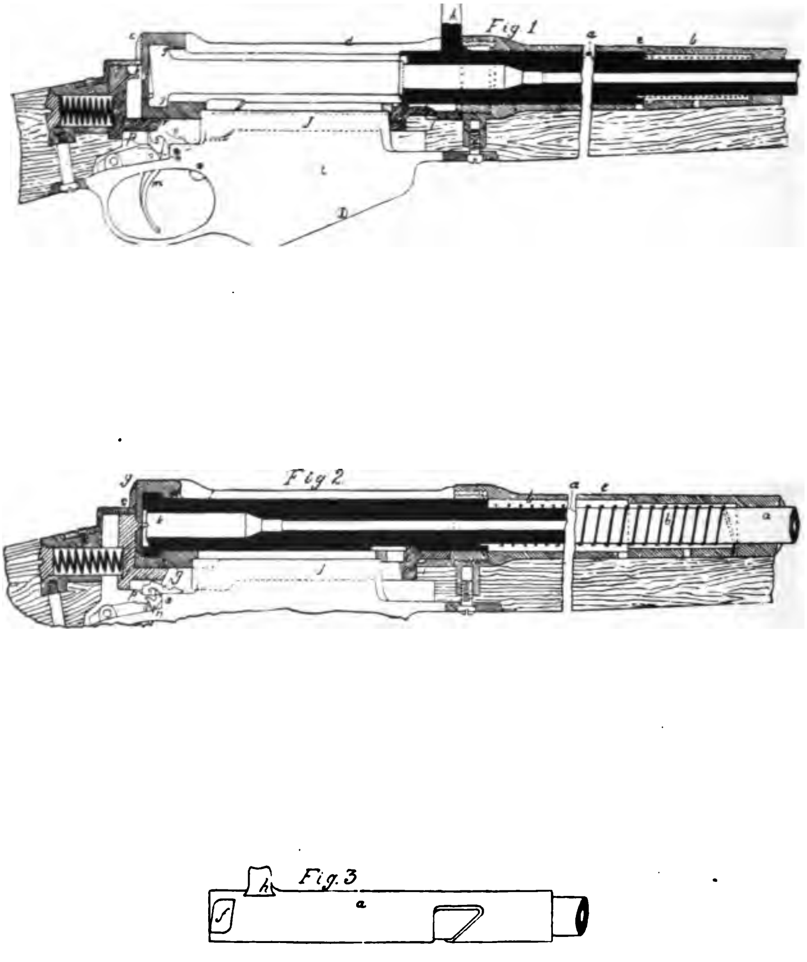
At 1,000 yards the average drop of the Mannlicher is about 1 in 28; Lee-Metford, 1 in 26. At 1,500 yards these bullets have about the same drop, viz, 1 in 10.4. At 2,500 yards these figures are 1 in 3 and 1 in 3.14, respectively. At 3,000 yards the drop of the Lee-Metford is 1 in 1.39.

Experiments for ricochet were carried out with the following results: On a level surface of smooth, hard sand the Lee-Metford gave the ratio of mean drop to mean rise as 13 to 18, whereas with the Martini-Henry the mean rise was double the drop. Deflections were both to the right and left, maximum 1 in 114, the mean deflection being only one-quarter that of the Martini-Henry. On level turf many bullets did not rise at 2,000 yards, and at 2,500 yards only about 5 per cent ricochetted.

The times of flight were approximately as given below:

Range.	Time.	
	Lee-Metford.	Mannlicher.
	Seconds.	*Seconds.*
500 yards	1	0.85
1,000 yards	2.5	2.2
1,500 yards	4.5	4.2
2,000 yards	6.7	6.5
3,000 yards	15.	15.5
3,760 yards	27.	....

A new clip system has been devised which combines the advantages of the two systems in general use in multiple loaders. This clip serves to hold the five charges in transportation, allows them to be entered with it into the magazine in about the same time taken to place a single cartridge, and yet does not form an essential part of the magazine when once entered. The action of charging releases the cartridges when the clip has been pushed home, the clip then drops out below, leaving the cartridges free in the magazine. This system also allows the magazine to be charged with single cartridges, and admits of use as a single loader. It appears to be the ideal clip system.



MANNLICHER AUTOMATIC BREECH MECHANISM.

The following description and illustration of the Mannlicher automatic system is taken from "Arms and Explosives." It is believed to possess certain advantages. For illustrations *see* figs. 1, 2, and 3.

In the automatic firearms known heretofore either a sliding barrel is employed, which, together with the breech bolt, is driven back by the recoil of the shot and moved forward again into its normal position by a spring or by the closing breech bolt; or the barrel is stationary and only the breech bolt is driven back by the recoil and closed again by a spring. In the automatic firearm to be here described no sliding breech bolt or movable breechblock is employed, but only a rigid tail or butt plate, which alone receives the recoil of the shot, while the barrel, in consequence of the reaction, receives a forward impulse, following which it leaves the butt plate and slides forward a certain distance. The normal closed position of the barrel shown in fig. 1 is not therefore the forward one as in other automatic firearms, but the rearmost position shown in fig. 2, in which it is held by a suitable spring. Contrary to all automatic firearms known, the barrel of the firearm of this invention is driven forward by the firing of a shot and moved back again into its normal position by a spring which has been compressed during the forward movement. This construction may be applied to firearms of various kinds. In small firearms—such, for instance, as pistols or light rifles—the barrel may have a straight forward and backward motion and may freely rest with its end against the rigid butt plate, without any locking device whatever being required, the pressure of the spring and the inertia of the barrel offering sufficient resistance at the moment of firing a shot to insure correct and safe operation of the mechanism. In firearms using heavier charges a greater resistance to the forward impulse of the barrel is secured by giving the barrel a rotary movement and by providing it at its rear end with locking studs and the receiver near the butt plate with corresponding locking grooves. The mechanism consists essentially of the sliding barrel *a*, the spring *b*, now under consideration, and the butt plate *c*. The receiver *d* is closed at its rear end by the butt plate, and to the forward end of the receiver is attached a tube or casing, *e*, in which the barrel is guided and which contains the spring *b*. At its rear part the barrel *a* is provided with the locking lugs *f f*, which are shaped and placed in the manner of screw threads, and which fit into corresponding grooves or recesses *g g* in the receiver. When, through the firing of a shot, the barrel receives its forward impulse, the pitch of the locking studs in their recesses causes the barrel to perform a rotary movement, whereby the studs are turned out of their recesses in the receiver. As soon as the studs have left the recesses the barrel is carried forward by its momentum until it is arrested by a suitable stop in the receiver or in the guide tube *e*, as shown. In this forward movement the barrel compresses the spring *b*, and as soon as its forward movement is arrested the spring will drive the barrel back against the butt plate *c*, while the studs will give it its locking turn as soon as they engage into the corresponding recesses. The opening rotation of the barrel brought about by the slanting stud may either be assisted or retarded, according to the direction of the rifling in the barrel, by the rotary tendency imparted to the barrel by the projectile moving in the rifling. As already stated, the barrel may also be used without any locking device, in which case its movement will of course only be longitudinal, but otherwise the operation or construction of the described mechanism will not in any way be altered. For opening and closing the barrel by hand a handle, *h*, is provided. A firearm of the kind described may be used as a single loader, but as a matter of course it is by preference provided with a magazine. In the drawing a magazine, *i*, is shown placed underneath the receiver, but any other kind of magazine may be used. By way of example a firing mechanism is also shown, the cocking of which is effected automatically by the movement of the barrel. An elaborate description of it is not necessary, and it will be sufficient to say that it consists of a slide, *j*, which carries the firing pin *k*, and extending forward terminates in a stud, *l;* this stud engages with an inclined groove cut in the barrel, and is carried forward, when the barrel commences to rotate under the influence of a discharge, until it comes in contact with the sear, which retains it in readiness for the next shot. The trigger *m*, to which is pivoted a hook, *n*, and the sear *o*, which terminates at its rear end in a hook, are held in correct position by suitable springs; in their normal position the hook *n* of the trigger is in engagement with the hook of sear *o;* when, however, the slide *j* occupies its forward uncocked position, a shoulder, *p*, of the latter bears against hook *n* and keeps it out of engagement with the hook of sear *o*. When the slide is drawn to the rear and cocked, the hook *n* at first is liberated only so far that it will rest against the lower side of sear *o*, without, however, engaging into the hook of the latter, which is also kept depressed by the slide. After this rearward cocking movement of the slide has been completed, the sear *o* becomes free to rise with its rest *q* against the rest *r* of the slide, whereby the latter is arrested in its cocked position, while at the same time the hook *n* can engage with the hook of the sear *o*. If now the trigger is pulled, its hook *n* draws the sear *o* downward by its hook and releases the slide. An untimely release of the slide and thereby an accidental discharge of the shot before the barrel is locked is prevented by the position of part *s* of the slide in the step or recess *t* in the receiver, which it can not leave until the stud *l* has entered the recess *u* of the barrel, that is, until the latter has completed its locking movement. When the magazine is to be charged, the barrel has to be opened by hand and pushed forward; in order to keep the barrel in this position a special recess is provided in the interior of the receiver, which is not seen in the illustrations. The barrel spring *b* having a tendency to turn the barrel to the right, will cause one of the locking studs *f* to enter and be caught in this recess, whereby the barrel is arrested in this position. After the magazine has been charged, a slight turn to the left given to the barrel will suffice to clear the barrel, when it will be driven back against the end or butt plate *c* and locked by its spring. The butt plate is provided with an extractor and an ejector of known construction. The rear end of the barrel may be provided with an inclined surface for loosening the cartridge shells in the usual manner.

ARGENTINA.

The manufacturers have delivered 120,000 7.65-millimeter (.301-inch) Mausers, M/91, and 30,000 more are ordered.

AUSTRIA.

The 8-millimeter (.315-inch) Mannlicher is still being manufactured for Austria, and the Landsturm is to have it to replace the Werndel. Vienna papers state that as a result of exhaustive trials the 5-millimeter (.197-inch) has been selected for this country. It is believed, however, that this piece has not yet left the experimental stage, and that Austria will not re-arm at present unless forced to do so.

BELGIUM.

Re-arming with the 7.65-millimeter (.301-inch) Mauser, M/89, still continues. The number of cartridges carried per man is said to have been reduced from 180 to 120.

BRAZIL.

This country has ordered 70,000 7-millimeter (.276-inch) Mauser rifles, Spanish model (p. 172, General Information Series No. XIII). Deliveries were to have begun in October last.

CHILE.

In the fall of 1894 Chile ordered 60,000 7-millimeter (.276-inch) Mausers from the Loewe Works, Berlin.

CHINA.

During the past year this country has purchased a large number of rifles of various models. Her infantry armament now includes a great variety of systems and calibers.

FRANCE.

It is known that .256 and .236-inch rifles have been tested in this country and still smaller calibers were to have been tried. Various papers state that a selection has been made of a new arm.

GREAT BRITAIN.

Experiments in India to determine the lifetime of the Lee-Metford barrel with cordite ammunition show that 3,000 shots may be fired without material decrease in accuracy, but a few hundred more ruin the barrel. This is considered a ten-years life.

The work of re-arming the navy and marines has already begun, but can not be completed before the end of 1897. The number on hand is sufficient to arm all regulars, militia, and reserves. Carbines are still being made.

ITALY.

Owing to the expense, re-arming with the 6.5-millimeter (.256-inch) M/91 goes on slowly.

MEXICO.

It has been proposed recently to adapt to the Daudeteau rifle certain features of another system, the Mondragon. This seems to indicate that Mexico has not yet fully decided upon a system. An order for 8,000 Spanish Mausers was recently filled.

NETHERLANDS.

The newly adopted 6.5-millimeter (.256-inch) Mannlicher (p. 170, No. XIII) has been tried in Java and Sumatra, and has given satisfaction. The Government proposes shortly to purchase 133,000 rifles and 6,400 carbines. Shops are to be equipped at Amsterdam for the manufacture of the piece.

NORWAY.

Provision is believed to have been made for the purchase of 20,000 of the new 6.5-millimeter (.256-inch) Krag-Jorgensen rifles. This number, with 4,000 to be made in home factories, will arm the line battalions. The reserves will wait until 70,000 are in store.

ROUMANIA.

The order for the 6.5-millimeter (.256-inch) Mannlicher rifle having been filled by the Steyr factory, Austria, 22,000 carbines are being furnished of the same system and caliber. Both officers and men are said to be well pleased with the arm.

RUSSIA.

The Mouzin or 3-line rifle, M/91, not having as yet been illustrated in the annual, the following description and figures 4 and 5 are taken from an English work entitled "Text Book for Military Small Arms and Ammunition":

> The Russian rifle, with a caliber of 7.62 millimeters (.30-inch), which is to supersede the single-loading Berdan II rifle of 1871, caliber 10.66 millimeters (.42-inch), is a magazine gun on the general lines of the Belgian Mauser.
>
> The barrel, which is uncased, is strongly reinforced at the breech and screws into the body. The fore-sight block and back-sight bed are brazed on.
>
> The front sight (1) is a barleycorn dovetailed into its bed at right angles to the axis of the barrel. The back-sight bed has five steps (2) for the slide. The leaf and spring are of the usual pattern, the leaf being hinged to the front (3) of the bed. The slide is of simple pattern, without any clamping arrangement; it has a small V notch in it. The cap has a similar notch for the short ranges and another on the top edge for the extreme elevation.
>
> The body is somewhat similar to that of the Belgian rifle; in front are recesses for the locking lugs of the bolt head, which are led into by cam-shaped grooves. On the left side is another recess and cam-shaped groove for a small lug (*d*) on the bolt cylinder. In rear of the magazine opening the sides of the body are connected by a bridge of metal, which is shaped out in front to receive the loading charger; in rear it has an inclined plane against which the bolt lever bears in opening and closing. This arrangement, together with the cam-shaped grooves for the locking lugs of the bolt head, give the "primary" extraction. A deep recess (4) is cut in the

RUSSIA 1891.

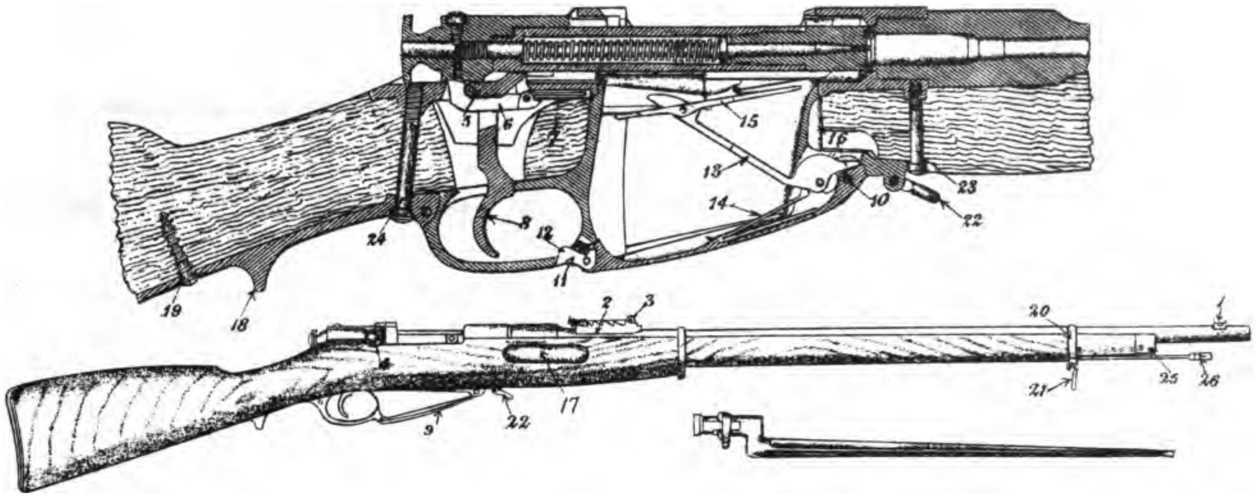


Fig. 4.

RUSSIA 1891.

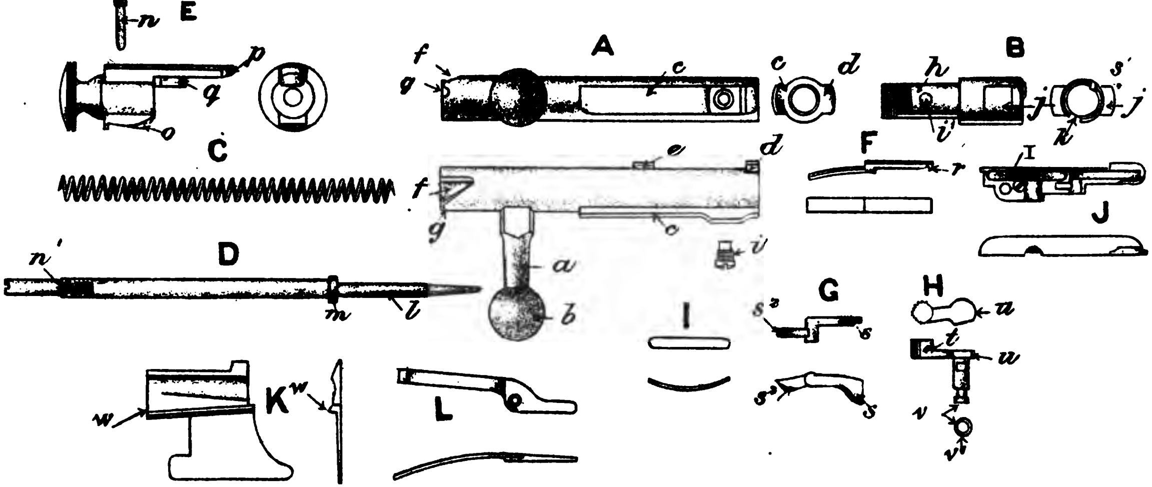


Fig. 5.

right side behind the bridge for the bolt lever to turn down into, which forms a further locking arrangement. On the left side are recesses for the ejector and safety bolt with its spring. The underneath portion of the body in rear of the magazine opening has a groove cut in it, into which the sear and bolt-retaining block project and in which the cocking stud travels.

The bolt A is a cylinder with straight lever (*a*) terminating in a knob (*b*) at right angles to it. There is a strengthening rib (*c*) on one side, and in front on the other side is a small lug (*d*); there is also on this side a small projection (*e*). The functions of this lug and projection will be explained hereafter.

A cam-shaped recess (*f*) and small notch (*g*) are cut in the rear end of the cylinder.

The bolt head, B, is a separate component with a long tenon (*h*), which screws into the bolt cylinder. A screw (*i*) passing into it (at i^1) through the strengthening rib on the bolt further secures it and causes it to rotate with the bolt. There are two locking lugs (*j j*) opposite to each other at the front end of the bolt head, and a groove (*k*) cut for the extractor. The face of the bolt head is recessed for the base of the rim cartridge.

The bolt is bored out from the front for the mainspring C, of 0.05-inch wire, with thirty-four coils set to a length of 5½ inches. The rear end bears against a seating in the bolt cylinder.

The striker D has a long point (*l*) with a collar (*m*) for the front end of the mainspring to bear against.

The striker passes through the rear of the bolt and screws into the cocking piece, E; it is further secured by a screw pin (*n*), which passes right through it (at n^1) and the cocking piece. The cocking stud (*o*) projects downward and works in the groove cut in the body. On top the cocking piece projects to the front, the projecting piece (*p*) traveling in a slot cut in the bridge of the body. This projection has a tooth underneath (*q*) which is shaped to fit into the cam-shaped recess (*f*) of the bolt cylinder.

The extractor, F, is a flat spring terminating in front in the usual claw (*r*) and lying in the groove (*k*) in the bolt head.

The ejector, G, is a small pin let into the left side of the body, having two horizontal arms which can project into the boltway, one on either side of the pin, which acts as a pivot. The front one (*s*) is the ejector, and a slot (s^1) for it is cut in the bolt head; it does not ordinarily project into the boltway. The rear arm (s^2) of the ejector projects into the boltway, except in the final motion of drawing back the bolt, when the small lug (*d*) on the bolt cylinder, striking against it, pushes it out of the way, and so turns the ejector arm to catch the base of the cartridge, releasing it from the extractor and ejecting it.

The retaining bolt (5), which is part of the trigger, is pivoted underneath the body and projects into the boltway. The small lug (*d*) on the bolt cylinder comes up against it when the bolt is drawn back and prevents the withdrawal of the bolt.

To remove the bolt the trigger must be pulled to the rear; this depresses the retaining bolt, and the bolt can then be drawn out.

The sear (6) is a lever pivoted to the body, passing through a slot in the trigger head, and projecting into the groove of the body, in which the cocking stud travels. It is actuated by a V spring (7).

The trigger (8) is pivoted to the underneath of the body, and has a slot in it through which the sear passes. The horizontal arm of the trigger in front of the pivot bears on the sear and depresses it when the trigger is pulled. There is a double pull-off.

The safety bolt, H, consists of a pin fitting into the left side of the body in the rear of the ejector. The pin has a horizontal arm, the long end of which ends in a thumb piece (*t*); the short end (*u*) is a disk with a flat on one side and a projection on the other. By turning the thumb piece round from rear to front the projection enters a recess in the bolt cylinder when the latter is in the closed position; this locks the bolt by preventing the bolt cylinder from turning. The lower end of the pin is partly cut away (*v*), and when the safety bolt is in the normal position a projection on the left side of the trigger arm is free to move downward; if the thumb piece is turned from rear to front as before, the firing pin being at full cock, the portion of the pin which is not cut away (v^1) is interposed under the projection on the trigger, and prevents its being depressed. The safety bolt is actuated by a spring, I, contained in a cover, J, which is fixed on the left side of the body, and protects the ejector and safety bolt arrangements.

The action of the bolt mechanism resembles in principle that of the Belgian rifle already described, and can readily be followed from the drawing and description of the working parts given above.

The magazine, which holds five rim cartridges, is a fixed one, being made in one piece with the trigger guard. The left side is slightly cut down in rear, the gap so formed being covered by a plate, K, fitting into it, and capable of a slight outward motion to the left. This plate has a rib (*w*) which projects slightly into the magazine, just engaging over the fourth cartridge; a strong curved spring, L, keeps the plate pressed up against the side of the magazine; the plate can, however, be pushed aside by the pressure of inserting the cartridges into the magazine. The object of this plate is twofold; it retains the top cartridge in the magazine until it is forced forward out of it by the forward motion of the bolt, and, secondly, it holds down the next cartridge until the final motion of closing the bolt, when the plate is forced to the left by the small projection (*e*) on the bolt cylinder, thus releasing the cartridge into the loading position. The next cartridge being held down in this way until after the extractor has gripped the cartridge which is being loaded, which does not occur until it is entirely in the chamber, prevents any chance of double loading and consequent risk of a jam or explosion, because the cartridge must be extracted and ejected before the bolt is free to push forward another one out of the magazine. The bottom of the magazine (9) opens on a hinge (10) in front, and is secured in rear by a small spring catch (11), the thumb-piece (12) of which projects into the trigger guard. The feeding arrangements are pivoted to the front of the magazine bottom, and consist of a lever (13) actuated by a V-spring (14) let into the bottom of the magazine; the long arm of the lever carries the platform (15), and the short arm (16) bears on the front end of the magazine bottom and regulates the upward motion of the long arm and platform.

The five cartridges are carried in a charger stamped up out of sheet steel, in which they are held by two small tongues folding over on to the two end cartridges. To charge the magazine the charger is placed into the recess cut for it in the bridge of the body, and the cartridges forced out of it by the pressure of the thumb. The charger when empty must be removed by the hand. There is no cut-off, and the rifle can only be used as a single-loader when the magazine is empty; but it can be replenished at any time by the introduction of one or more single cartridges. The cartridges are placed in the charger, the center one standing on the rims of the cartridges on either side of it, which in their turn stand on the rims of the two end ones.

The stock is in one piece; there are fore-end grooves (17). The pistol grip (18) is formed by a roughened projection, which is a prolongation of the trigger guard, to which it is attached by a screw; a wood screw (19) secures the other end to the butt.

There are two ordinary bands, secured by screws with nuts and keeper pins through the stock. The upper band (20) carries a sling swivel (21); a second swivel (22) is attached by means of a screw to the front of the magazine.

The body, stock, and magazine are held together by two screws passing up from underneath, one (23) in front of the magazine, the other (24) in rear of the trigger guard.

There is a plain nose cap (25) secured by a screw passing through the fore end.

The butt plate is secured by two screws; it is of steel, and has an enlarged heel. There is no butt trap.

A short cleaning rod (26) screws into a rod nut in the fore end. The head is plain, with a slot in it.

A long bayonet of + section is attached to the rifle by means of the old-fashioned bayonet-joint locking ring.

The modifications are the omission of the metallic plate in the rear of the trigger guard, which carried a cleat or support for the right hand, the addition of a wooden hand guard, and the modification of the cleaning gear.

SPAIN.

Thirty-five thousand of the new Spanish Mauser rifles (p. 172, No. XIII) and 5,000 carbines have been delivered. Manufacture of the piece in Spain was to begin about July.

Experiments have been made to fit the 11-millimeter (.433-inch) Remington (of which Spain has 250,000) with the .276-inch barrel, with a view to giving it to the second reserve. With changes in the breech mechanism to enable the piece to withstand the higher pressure, satisfactory results are said to have been obtained.

SWEDEN.

As stated on page 173, No. XIII, the Mauser system has been adopted for this country, caliber 6.5 millimeters (.256-inch). A contract for 8,000 carbines for the army has been signed, which will probably be furnished this year. Funds have also been voted for the manufacture of a number of these rifles in Government factories. It is practically the Spanish model. The modifications are the addition of a nose to the rear and top of the firing pin nut and a rib on the bolt for guiding it in the receiver.

SWITZERLAND.

The supply of the Schmidt 7.5-millimeter (.296-inch) rifles for the army is complete, and the M/93 carbine of the same caliber is being supplied.

TURKEY.

Early in the present year the issue of the 7.65-millimeter (.301-inch) rifle to the army was ordered and instructors appointed.

IV.

PROGRESS IN THE NAVAL USE OF ELECTRICITY.

Lieut. B. A. Fiske, United States Navy.

A contest is going on between electro-mechanical and other mechanical apparatus in very many of the important operations in ships and forts, which promises to be as lasting and as bitter as the contest between steam and sails. Each art is improving and each art has its champions. No one can tell with which will reside the ultimate victory, if the ultimate victory ever decisively comes. No sooner does an electrical device score a success than some ingenious person does the same thing with mechanics; and no sooner does an important mechanical invention accomplish some new thing than an electrician throws it altogether into the shade by a novel use of electricity. It may be stated as a general law—but with the distinct understanding that it is only general—that mechanical appliances have the advantage of greater simplicity of principle and that electrical appliances have the advantage of greater simplicity of operation. To paraphrase this statement, mechanical appliances are easier to understand, but electrical appliances are easier to use. Mechanical appliances require less instruction for their use. Electrical appliances render available a higher grade of intelligence, but also require a higher grade of intelligence. Electrical appliances strive for an ideal; mechanical appliances do what is required at the moment. The advantages of maturity and experience are on the side of mechanical apparatus; but youth and the promise of the future reside with electricity. Mechanical appliances are less apt to deteriorate from disuse; electrical appliances are less apt to deteriorate from use; mechanical connections are liable to give out under the sudden strain of an emergency; electrical appliances, from their nature, suffer little strain in use, and are not apt to fail in emergency, if found to be in condition before the emergency occurs. A mechanical connection, if broken or injured, gives plain sign of the whereabouts of the trouble, but the trouble is with difficulty repaired. A trouble in an electrical connection is sometimes hard to find, especially if the apparatus is not thoroughly understood, but, when found, is remedied with ease. The difficulty of repairing a break or disarrangement of a mechanical appliance, caused by a stress, is usually in proportion to the greatness of the stress; but with electrical appliances the cause of trouble is usually minute.

The most important enemy of electrical appliances on shipboard has been the "fatal facility" with which bad electrical apparatus can be installed. It has always been so easy to run a wire or to put in a battery, or a bell, or a dynamo, which would work for a week, that in very many cases it has not worked any longer. Good work on electrical apparatus often seems so unnecessary that slipshod work is substituted, and it does as well as any other for a while; but suddenly the apparatus fails, and then one hears on all sides complaints of the untrustworthiness of electricity. Nevertheless it is a fact that the naval and military uses of electricity are increasing. The same reasons that have filled modern cities with telephones, telegraph, electric motors, and electric lights are filling our modern warships and fortresses with them. The same reasons that gradually replaced the club of the savage with the magazine musket of the modern soldier are operating to replace the simple ships and batteries of a few years ago with warships of tremendous power but vast complexity. It seems to be a law of nature that we must pay for what we get. If we will have monstrous engines of war, directible with precision and rapidity, we must use complex machinery, protest as we may.

ELECTRIC LIGHTING.

No important change has taken place in the electric lighting of ships since the publication of the last annual. The principles previously laid down have been proved correct in practice, and the present development is along the lines of an increasing supply of lights and the gradual improvement of the details of wiring and insulation. The number of officers and men acquainted with electrical things has naturally increased, and this has brought about a better functioning of the apparatus used, as a necessary result. Search lights of automatic feed, controllable from a distant point, have proved practicable; but considerable diversity of opinion still exists as to whether the lights should be high above the water or low down, but the advocates of high positions are gaining ground. No important change has taken place in signal lights.

ELECTRICALLY OPERATED STEAM WHISTLES.

These have been recently tried in both warships and merchant ships with promising results. They do not interfere with the ordinary method of sounding the whistles, so that their use seems to confer a distinct advantage with no offsetting disadvantage.

MOTORS.

The use of electric motors is clearly on the increase, especially for ventilating, the training of turrets, and the hoisting of ammunition. Perhaps the advantages of electric power over steam are more obvious in the matter of ventilation than in any other field, the principal gain being in the fact that the necessity is avoided for the tremendous air ducts, which take up so much room in coal bunkers and living spaces, and in the substitution of a number of comparatively small ventilators, each placed where it is wanted, in the stead of the large steam-driven blowers for which room is so hard to find. The military advantage of the small electric ventilator is one that may easily be overlooked; but it is a well-known fact that in many ships the steam blowers have had to be placed above the water line and absolutely unprotected; which means that in the early part of an action the blower supplying one or more of the magazines may, and probably will, be put out of operation by a very insignificant cause, and make it absolutely impossible for the men to remain in the magazines.

For training guns, the practice of employing motors is becoming limited to turrets, the mechanism being arranged in such a way that hand power can be used in case of accident. As regards the relative advantages of the three principal powers—steam, hydraulic, and electrical—a wide diversity of opinion exists. The great desideratum of simplicity resides, of course, with steam, and many regard this feature as of paramount importance. Others, however, while admitting the superior simplicity of steam, and while admitting the enormous value of simplicity, point out the extreme difficulty of securing a "dead beat" motion with steam, even if a worm and screw be included in the mechanism. They also point out what at first sight may not seem an important point, but which may readily become so—the question of heating; insisting that, no matter what mechanism may be employed, it is after all "the man behind the gun" on whom we must rely, and that the man behind the gun and the men in the passing rooms will not work at their best in an unendurable heat.

The great advantage of hydraulic training, arising from the incompressible nature of water, is the absolute rigidity with which the turret is held. If the valves are closed, the turret can not move; and the turret can never make the water motor go at a greater speed than that for which it is set. In the sighting hood, the continuous turning of a wheel by the operator at any desired speed, controls, on the floating-lever principle, the speed at which the turret will go. The control is almost ideal; but electrical men claim that they can secure the same precision with electric means, and that they can give the turret a motion just as quick and as fine; and they proceed to point out how pipes burst and valves leak just when called on to work hard. In most, if not all, of the plans hitherto tried for electrically training turrets, however, control of the motors' speed has been sought through the putting of more or less resistance in the circuit of the armature; and the difficulty of handling large turrets by this means is great, and the means thus far employed hardly to be called satisfactory. In determining why they are not satisfactory, let us consider what is needed in order to control the training of a turret in a seaway. The turret weighs 100 tons or more, and it is rare that its center of gravity is in the axis of rotation. As the vessel rolls from side to side, the turret tends to move by its weight in one direction or the other, the effect being at a maximum when the guns are pointing ahead or astern. Let it be supposed that the turret is pointing ahead, and is stationary, and that the turret captain wishes to train it to point at a target on the starboard beam. He moves his lever to the front, and the turret starts to turn slowly, the great mass of the turret preventing its suddenly taking up a rapid motion. Just now the ship begins to roll to port and the turret has to climb uphill, besides being accelerated. As the roll continues, the hill becomes steeper, until it reaches a maximum, and then it becomes less and less steep, until an even keel is reached. This has taken, say, eight seconds, and the turret has just about reached the speed at which it is intended to run, when the ship starts to roll to starboard; the turret now tends to run downhill, and the motor is doing its best to help it. Evidently, the arrangement of the motor must be such that without any conscious effort from the operator the turret will be prevented from running downhill, for the mass is so great that the consequences of mental confusion or inattention on the part of the operator might be serious. In other words, the motor must be arranged so that it can not run above a certain speed. This is usually expressed by saying that we must use a "constant-speed motor."

It has been objected frequently, however, that constant speed is not needed, nor even desired; that what is wanted is simply ability to get the turret quickly around to the target and to move it quickly to the right or the left in order to keep the guns pointing at the target.

Without wishing to detract in any way from the importance of these points, it must be insisted that everything should be done to make the gun captain's work easy; that his mind should be as free as possible from mental calculations, his lever as easy to move as practicable, and that the movement of the turret should bear a definite relation to the movement of his lever. Let us suppose that this is not done, and that the turret's speed depends on other causes than the movement of his lever. Is it not plain that the captain will have to jerk his lever around more frequently and tentatively, more spasmodically, than he would if each position of his lever meant a certain speed? If each position of his lever can be made to mean a certain speed—regardless of everything external—is it not plain that, with a little practice, and even if the gun captain does not know anything in figures about either the position of his lever or the revolutions of the motor, he will yet insensibly come to feel that he with his own arm is moving the turret and that his own will controls its speed? Can he not then follow a moving target with far greater precision than would be possible if the turret would spasmodically speed up or down from moment to moment, as the ship rolled?

It is not an answer to this to say that it is impossible to get constant speed under the circumstances, that the speed and direction of the turret must frequently be changed, that it will always take a certain interval of time for the heavy mass to make the change, and that during the interval the speed of the turret will be either increasing or decreasing. This objection, while it includes a true statement, is really misleading, because it amounts to saying that, if perfect control of any machine can not be obtained, we should therefore refrain from attempting to make the control of the machine as perfect as we can. To attempt the control of a turret in a seaway is like trying to solve a problem containing many variables; and it is axiomatic that the solution of any such problem is easy in proportion to the reductions we can make in the number of variables. Applying this principle, we are forced to the conclusion that the motor for the turret should be so arranged that its speed shall vary as little as possible from the speed set by the gun captain. Now, it is not hard to get a constant-speed motor; but unfortunately for any given electric potential applied to an electric motor, there is only one speed that can be constant; so that, in order to make a motor run at different constant speeds, different potentials must be applied, and each potential must itself remain constant during the interval of time for which the corresponding speed is desired. In other words, in order that the gun captain in the sighting hood may be able really to command the speed of rotation of the turret he must be provided with a system by means of which the potential which he applies to the motor shall not change, unless he himself intentionally changes it. Reverting now to the statement made before, that all methods of controlling turret motors are bad in which resistances are varied in the armature circuit, we see at once that it must be bad if the potential applied to the armature terminal is liable to change. That it is liable to change is easily proved, as follows:

If an electric motor is running at any speed, and if its load be suddenly increased by any cause, such as in this case, an increase in the heel of the ship when the turret is running up hill, the motor tends to slow down; this reduces the counter electro-motive force that the motor is generating and therefore increases the current in the armature. Now if a certain resistance (say $\frac{1}{10}$ ohm) has been put in the armature circuit when the armature current was 100 amperes, then, since $E=CR$, the voltage expended in heating this resistance $=100\times\frac{1}{10}=10$ volts, and the voltage of the armature terminals falls from 80 volts to $80-10=70$, so that the motor is running really on a 70-volt circuit. Let now the load be increased, so that the current increases to say 200 amperes, the voltage now lost in the resistance $=200\times\frac{1}{10}=20$ volts, so that the motor will run at 60 volts, instead of 70 volts; the action, then, of an increased load on the motor has been automatically to decrease the voltage supplied to it.

In endeavoring to meet this trouble systems have been devised resembling some employed in working large cranes and elevators, and are on trial.

Besides constancy in the speed there are two other principal desiderata in the turning of a turret; first, sufficient speed to bring the gun on to a target, and to follow it when its direction is changing; and second, extreme nicety of movement, which means ability to move the guns quickly in one direction or the reverse through small angles.

In deciding upon the speed required, the question resolves itself merely into deciding how much money and space can be provided for the power, because the highest speed attainable is desired. The speed, of course, ought to be at least that necessary when two ships, say 1,000 yards distant, are passing each other at 15 knots each, because such a situation may easily occur. Two ships passing each other at this distance and speed change their relative directions per second through an angle of which the sine is $\frac{(15\times.57)\,2}{(1000)}=\frac{17.1}{1000}=\sin 1^\circ$ (approx.). This speed is clearly much less than would be required for handling the gun in a seaway, having regard merely to the uncertain motion of the ship itself. So, in our new ships, the speed specified is many times this even under a considerable heel, when the turret will have to run uphill.

The problem of quickly turning the turret becomes afterwards one for the electrical engineer. He is told that the weight of the turret is so many tons, that the friction is so much, that the center of gravity is so many inches from the center of rotation, and that he must make the turret run at a certain speed. The question is so far one of horsepower. But he must also be told that the motor must be so designed that it will not become stalled (i. e., unable to move) under any probable roll, because when a motor's armature is stationary the current through it is enormous, being ($C=E/R$) that due to the potential between the mains (in the United States Navy 80 volts) and the ohmic resistance of the armature itself. To guard against an excessive current, in case an extraordinary roll should stall the motor, it is well to put a safety device in the armature circuit.

As it would be impracticable to provide sufficient power to maintain constant speed under heavy rolls, it becomes necessary to prescribe that the speed shall be constant up to a roll of, say, 10 degrees, and permit that it may slow down when the angle of heel is greater, being careful that the speed shall never fall to zero under any probable circumstance.

The question of nicety of train, in the case that abundant power has been provided for the efficient rotation of the turret under ordinary rolls, is largely one of the construction of the switch which the gun captain moves. As the gun captain views the target through his telescope, the vertical and horizontal cross wires appear to be describing irregular curves against the background of the sky. His effort must be to bring these curves into the vicinity of the target. Though the motions of the cross hairs are seemingly erratic, they can, of course, be resolved into two motions, one horizontal and the other vertical. If the advance of the ship were in an absolutely straight line, and if the ship rolled the same amount from side to side and at regular intervals, the curve of the point of intersection of the cross hairs would be regular, and it would be comparatively easy to bring this intersection on to the target. But it is rare that a ship moves exactly in a straight line, in a seaway, even when steaming on a certain course, for she yaws gently from side to side. Neither does a ship roll regularly. Even under the best circumstances, she rolls a little more to one side than to the other, and the rolls vary in amount from time to time. Then a ship frequently comes to rest for a while on an approximately even keel, and then starts to rolling again. Besides the rolling, there is also the pitching, and this complicates the motion of the cross hairs, especially when the guns are pointing on the bow or quarter. The up and down motion is the quickest and the most irregular, so that the real problem is to so move the turret as to get the vertical cross hair on the target at the instant when the rolling throws the horizontal hair across the target and to press the firing button at that instant, changing the elevation of the gun itself as little and as seldom as possible. With a large field in the telescope the vertical wire shows the direction in which to move the turret, even when the horizontal hair is several degrees above or below the target, so that the success of the gun captain in keeping the vertical hair across the target is dependent on the ease with which his switch can be moved, as well as on the response of the motor to the switch; and it is absolutely essential that the moving of his switch must not in the least disturb the position of his eye at the telescope. For this reason the movement of the switch must be to the front and rear, and not to the right and left.

ELECTRICAL FIRING OF GUNS.

When one reflects that a vessel rolls from side to side in about 8 seconds on an average, that even under very good circumstances she rolls more than 1 degree per second, and that with the modern guns an error of 10 minutes of arc in the elevation of a gun above the horizontal at the instant it is fired means an error of about 200 yards in the distance the projectile will go, and that in the case of a ship 2,500 yards distant, this error of 10 minutes of arc will throw the projectile about 22 feet above or below the point aimed at, we see that it is necessary to fire the gun in such a way that a less time than ten-sixtieths=one-sixth of a second of time will elapse between the time that the gun captain makes up his mind to fire the gun and the time that it is actually fired; unless the gun captain resorts to the method of firing his gun before his cross hairs rest on the target, by an interval of time which he estimates will be such that when the gun is actually fired the cross hairs will actually rest on the target. Of course, this method is often used with great success, and a "born shot" can, with sufficient practice, so use it; in fact, "born shots" do successfully use it, but only "born shots" can, and even they need more practice than is given or can be given in any navy in the world. To place accurate gun firing within the reach of ordinary men, electrical firing is used, in which the captain can fire without taking his eye from his telescope (or sights), and by such a slight pressure of his fingers that he can fire very quickly after making up his mind to fire, and, what is fully as important, without moving his eye from the telescope. Practical results show more accurate firing with electricity than with either percussion or friction. Complaints are sometimes heard of the untrustworthiness of electrical firing; but if electrical firing apparatus is properly installed, it is more simple and trustworthy than any other means. The real trouble is that as yet there are not enough people on shipboard who understand electrical apparatus. As to concentration of fire by electricity, it has few friends and they are thinning out rapidly, as the system serves no useful purpose.

TELEPHONES.

The telephone is gradually making its way against the speaking tube. The latter has the advantage of simplicity of principle, the telephone of distinctness. The speaking tube is less apt to get out of order; the telephone does better service when it is in order. The speaking tube is more difficult to lead through the devious labyrinth of the compartments and it occupies valuable space, and while the telephone is not difficult to keep in order, the connecting wires sometimes get disconnected. The telephone has not as yet had a fair chance on shipboard because it is comparatively recently that the long-distance "solid-back" transmitter has been introduced. So far as the writer's experience goes, the persons who are not acquainted with this telephone prefer the speaking tube, while those persons who are acquainted with both prefer the telephone.

The principal disadvantage of the telephone for military use is one which it possesses in common with the speaking tube; that is, that it is a very inefficient instrument when used by a person under excitement. With both the speaking tube and the telephone clearness of articulation and a voice not too loud are necessary, if the message is to be quickly and unhesitatingly understood at the other end, and men under excitement are sure to speak loudly and not very distinctly. For the transmission of orders, therefore, and for signaling to the engine rooms, helm, and guns, visual indicators are coming into use. Visual indicators possess, besides the advantage of distinctness, the additional advantages that they do not add to the noise on shipboard and are not affected by it, and that the message which they bear remains in evidence until it is replaced by another message, so that "the last order" can always be referred to by a glance of the eye.

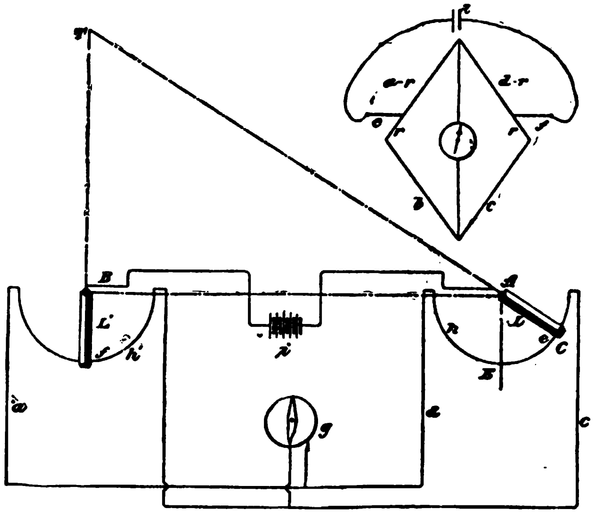
The writer has been engaged for some years in perfecting a system of electric apparatus for use in ships and forts which has of late emerged from the experimental stage and seems to contain the possibility of considerable usefulness. Most of this apparatus is based on a central principle of construction, which aimed to avoid the inherent difficulty of previous electrical apparatus when used in or near sea air. This difficulty was apparently a trivial but really an almost insuperable one; the sea air attacked and corroded the metallic contacts with which the apparatus was filled. In nearly, if not all, the electrical apparatus used for signaling, the mechanism consisted of a train of wheels which were moved by a pawl and ratchet, the pawl and ratchet being moved, in turn, by an electro magnet, which pulled the ratchet wheel down one tooth every time the current was made and broken. Even the simplest mechanism made on this plan contained many parts, most of them small, and the greatest care was needed to keep everything in order. The only safety lay in hermetically sealing the cases; and this was far from satisfactory and made the mechanism inaccessible. In endeavoring to find a way out of the difficulty the writer conceived the idea of using only unbroken circuits, which were varied in strength by gradual variations and never by jumps, the variations being indicated by galvanometers and attained by the moving of a wiper over a continuous wire of high resistance.

THE RANGE FINDER.

This instrument has now been tested for somewhat more than five years. It will be remembered that the instrument is based, so far as the general principle goes, on the measurement of resistances of a conductor, in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, each arc corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the wire as the telescopes are turned in the angle to be pointed upon any object.

Let fig. 1 represent the arms of a Wheatstone bridge bent into the form of an arc *h′*, while *c* and *d* are bent into the form of an arc *h*, both of these arcs being wires of conducting material. Let telescopes, pivoted at A and B, be fitted with the contacts *e* and *f*. Now, if the extremities of the semicircular arcs are in the same line, the contacts carried by the telescopes will press on the middle parts of their respective arcs, and the galvanometer will, therefore, not deflect whenever the telescopes are parallel and at right angles to the base line, because, as shown above, *ac* = *bd*. But when the telescopes are parallel they are directed at some point in space infinitely distant; that is, the distance of the object toward which the telescopes are directed is infinite. The position of rest of the galvanometer needle is therefore marked "Infinity."

Now let the telescopes be directed at some point T not infinitely distant. The telescopes will converge and the angle of convergence is clearly the angle ATB, or the angle CAE, which is measured by the arc CE. In other words, the degree of convergence is measured by the difference in the positions of the contacts of the telescopes on their respective arcs. But if the bridge was in balance when both contacts were at the middle points, it will clearly not be in balance when one is at the middle point of its arc and the other at C; and the amount by which it is out of balance will clearly vary with this difference of positions; that is, the greater the amount of convergence of the telescopes, the greater the deflection of the galvanometer; so that the deflection of the galvanometer varies with the angle ATB. By trigonometry,



FIGS. 1 AND 2.

$$AT = \frac{AB}{\sin ATB} \times \sin ABT.$$

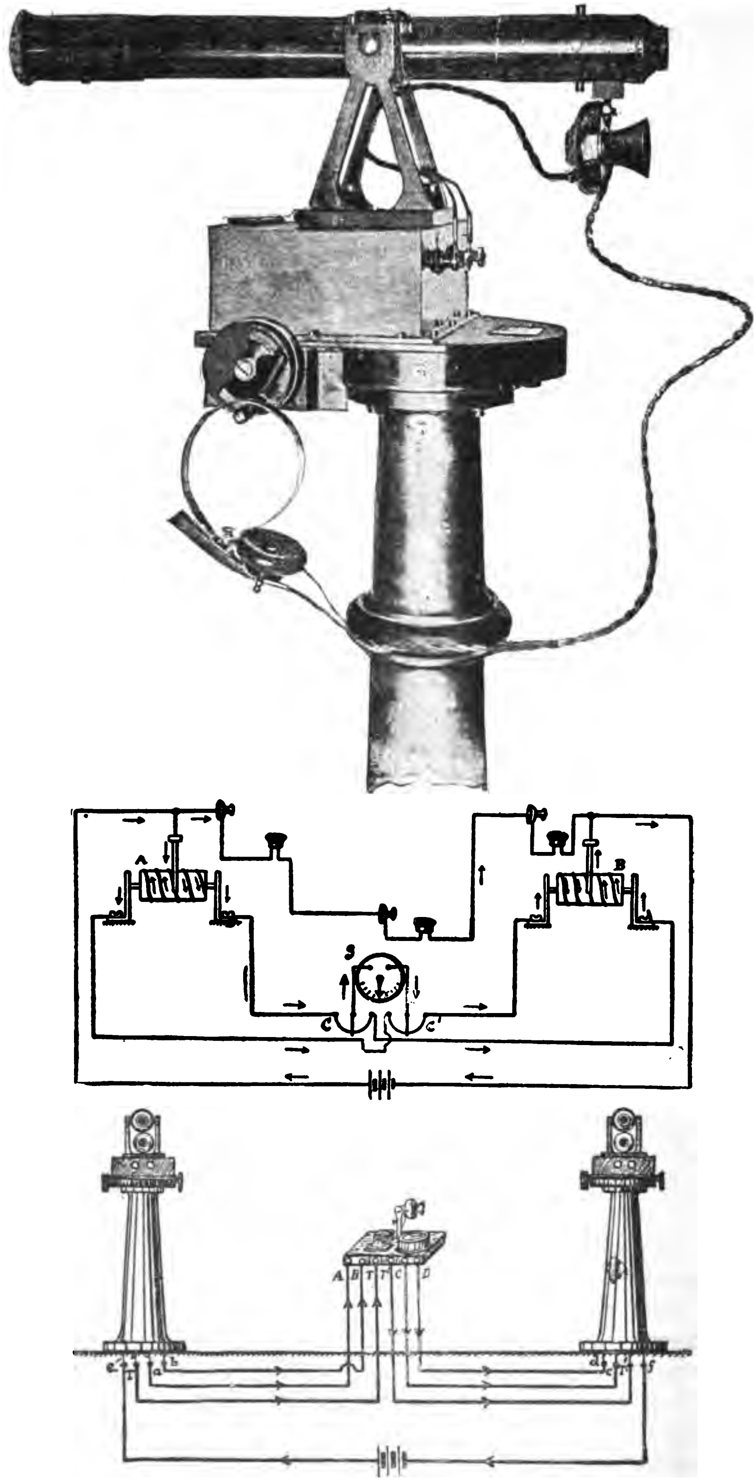
From this formula it is plain that if ABT be a right angle, the distance AT varies inversely with the sine ATB; and it is therefore plain that if the electro-motive force of the battery remains constant the deflections of the galvanometer vary inversely with the distance; so that if we know the length of base we may graduate the galvanometer directly in units of distance, remembering that with such small angles as ATB always is in range finding, the sine of the angle is practically the same as that of the arc.

But suppose that ABT is not a right angle. Suppose, first, that the target pointed at by the telescopes is infinitely distant, but in a direction inclined to the base. The contacts carried by the telescopes will not now press on the middle points of their arcs, but on points equally removed from the middle points. This is evidently the condition shown in fig. 2, where the contacts have been moved away from the middle points over equal resistances. The galvanometer will not deflect, but will remain at its position of rest, which position on the galvanometer is marked "infinity."

Let one contact be now moved from its position so that the telescopes converge and point at some object not infinitely distant. The galvanometer will deflect. In order to indicate the true distance of the object the galvanometer must now deflect, not in proportion to sin ATB, but in proportion to ATB ÷ sin ABT. In other words, it must deflect more for an angle of convergence ATB than if ABT were a right angle; and the smaller ABT is, the more the needle must deflect. In the range finder this increased movement of the needle is obtained by taking advantage of the curious fact that the current in the Wheatstone bridge increases as the contact points are moved away from the middle points. This is because the resistance of the bridge is less, so that if the electromotive force of the battery is constant the current increases proportionally as the resistance decreases.

In the apparatus as at present constructed the wire is not laid in the form of an arc, but is wound upon a cylinder of insulating material. A contact presses on this wire and as the telescope above (shown in fig. 3) is turned in azimuth the insulating cylinder revolves and causes the contact to press upon different parts of the wire. The special feature of value in this construction is that the wire is completely protected from the effects of weather, and, what is of more importance still, it makes it possible to use a device by which the nonuniformity of the wire is automatically corrected.

It has been said above that when the telescopes are parallel, and therefore pointing at some object infinitely distant, the contacts carried by the telescopes must press on the resistance wires at similar points, so that the galvanometer needle will not move from the infinity mark, no matter at what angle the telescopes are pointed. In order that this may be always the case, it is evident that we must have an exact equality in resistance per unit length of resistance wires or else we must have some device by which nonuniformity will be corrected. This is accomplished in the instrument in question by an arrangement of the contact by which whenever the telescopes are directed at similar angles the contacts automatically go to such parts of the wire that the bridge is in balance and the galvanometer indicates infinity.



Figs. 3, 4, and 5. Range finder.

Another feature introduced in the present apparatus is a temperature corrector, by means of which any change of temperature, either in the climatic or other conditions, and its consequent effect upon the resistance of the circuit is compensated. In fig. 4 the temperature corrector is shown at C C′ and consists simply of two similar arcs of wire introduced in the circuit between the two observing instruments at the ends of the base line, upon which arcs press the contacts of the galvanometer G. In case the temperature of either instrument, say B, is raised and its resistance correspondingly raised, it is simply necessary to move the two contacts of the galvanometer G along the arc C C′ a distance sufficient to compensate for the increased resistance of that instrument. In order to tell when this sufficient distance has been traversed it is merely necessary to set both instruments at similar angles and move the two contacts equally on C C′ until the galvanometer shows infinity.

This operation requires a few seconds only, and suffices to adjust the range finder for the temperature conditions which prevail that day. Fig. 5 shows a diagram of the circuit of the range finder. The two instruments at the opposite ends of the base line with their telescopes and telephones are shown. The arcs *a* and *b* of one instrument are connected to the arcs *c* and *d* of the other instrument through the temperature corrector which is mounted on the base of the reading instrument shown in the center. The telephones on the two observing instruments are connected together through the telephones on the reading instrument, and the battery contacts are connected to the storage battery, shown below, which is ordinarily in the dynamo room of the ship. On the same base with the temperature corrector is the galvanometer or reading instrument. The captain of the range-finder crew is stationed in the conning tower at the reading instrument and has all the devices for correcting the range finder under his hand. He sees what figure the needle of the galvanometer points at and telegraphs this figure to the guns by means of the electric range indicator.

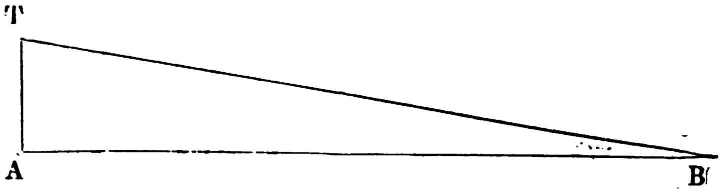
The shortest base line with which the instrument has as yet been used successfully in practice is in the U. S. S. *New York*, in which the base line is 46 yards, the observing instruments being placed on platforms on the masts. The average error with this base line, and under conditions of service, is just about 1 per cent for distances of 1,000 yards, 2 per cent for 2,000 yards, 3 per cent for 3,000 yards, etc.

THE STADIMETER.

The stadimeter is an adjunct to the range finder and is designed to be used in concert with it in such a way as to combine the portability and convenience of a one-observer instrument with the accuracy of a two-observer instrument.

As will be seen from the drawing, it is a modification of a sextant. It weights 3¼ pounds and is of the same size as the ordinary sextant used in ships.

The stadimeter can be used to measure distance of objects whose height is known, or the height of objects whose distance is known, the micrometer head M being graduated in yards of distance and the index bar B being graduated in feet of height.



Clearly, from the diagram

$$AT = BT \text{ sine } ABT; \text{ or}$$
$$BT = AT \div \text{ sine } ABT.$$

So that in either case the measurement involves the measuring of sine ABT.

To accomplish this with the stadimeter, bring the reflected ray from the top of the object into coincidence with the direct ray from its bottom by moving the index bar which carries the index glass I on its pivot in the same manner as in using the sextant. To move this index bar rotate the micrometer head M. The sine of the angle through which the index glass has been moved is clearly the amount by which the micrometer screw has moved longitudinally, divided by the distance from the pivot of the index bar B to the point on its edge where the force of the micrometer screw is applied. The german silver spring G presses the index bar against the end of the micrometer screw and prevents lost motion.

Now, by the theory of the sextant, the angle between the reflected ray from the top of the object and the direct ray from the bottom of the object is twice the angle through which the index glass has been moved out of parallelism with the horizon glass H. Therefore, assuming that for such small angles as those here used the sines of angles are proportional to their arcs,

$$AT = BT \times 2 \times \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of application of screw on index bar}};$$

or,

$$BT = AT \div 2 \times \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of application of screw on index bar}}.$$

As the length of movement of the micrometer screw longitudinally can be determined by the amount of angular movement of the micrometer head, it is plain that if we know the pitch of the micrometer

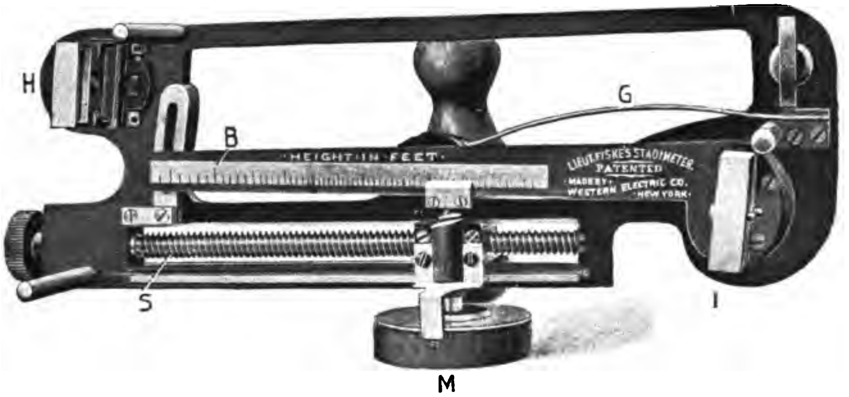

H
G
B
HEIGHT IN FEET
LIEUT. FISKE'S STADIMETER
PATENTED
MADE BY WESTERN ELECTRIC CO. NEW YORK
S
I
M

Fig. 6.—STADIMETER.

screw the micrometer head can be graduated in units of distance and the index bar in units of height, or vice versa.

In the stadimeter this is done, and furthermore the point of application of the micrometer screw on the index bar can be varied at will. This is accomplished by mounting the micrometer screw on a block or nut which rides on the long screw S so that by turning S the block or nut is moved in either direction.

To use the stadimeter to measure the distance of an object whose height is known, set the micrometer screw opposite that graduation on the index bar which indicates its height in feet, and bring into coincidence the reflected image from the top of the object and the direct ray from its bottom. The distance of the object in yards will then be found opposite the pointer on the micrometer head.

To measure the height of an object whose distance is known, assume the height to be 100 feet and set the micrometer screw at the 100 mark on the index bar. Proceed as before, and read off corresponding distance (which may be called D) upon the micrometer head. Obviously,

$$\text{True height} : 100 = \text{true distance} : D.$$

$$\text{True height} = 100 \times \frac{\text{true distance}}{D}$$

To avoid making even this simple calculation in the excitement of battle, a "table" printed on a card is employed.

The stadimeter may now be set at the true masthead height and used as explained above.

When employed in connection with the range finder in a naval battle, take the distance of the enemy with the range finder very carefully before the action has become hot, bringing her as nearly abeam as convenient, and when distant, say, 2,500 or 3,000 yards, find out her masthead height simultaneously with the stadimeter, and set the stadimeter at this height and keep it ready for use. If afterwards the range finder becomes disabled, or if it can not be used for any reason, proceed with the stadimeter.

A moderately skillful observer can get eight observations per minute.

The foretop is a good place in which to use the stadimeter, the observer being connected by speaking tube or telephone with the person who telegraphs the ranges to the guns.

In fleet actions endeavor, if possible, to get exactly the masthead heights of all the enemy's ships and make a memorandum, to be used when required.

Although the stadimeter is intended primarily as an adjunct to the range finder as a gunnery instrument, and although practical tests in service have found that it fulfills this intention satisfactorily, its principal usefulness will, perhaps, be found in squadron sailing and in navigation, the known heights used in navigation being those of lighthouses and other landmarks. The official reports from the *New York* and *Cincinnati* recommend its use in all ships.

RANGE-INDICATING SYSTEM.

In the accompanying drawings, fig. 7 is an electrical diagram illustrating the principle of the system, and showing one transmitting instrument, T, and ten receiving instruments, I, in circuit, each receiving instrument having an adjustable resistance in series with it, each adjustable resistance being in a metal box R; and fig. 8 is a view of one of the receivers or indicators I (fig. 7) with its resistance box R in position below it.

Referring first to fig. 7, AB is part of a conducting circuit which includes the battery ı|ı|. T is a galvanometer, which is connected in shunt with AB, one terminal being fixed at the point A and the other terminal or contact C being movable along the conductor AB. It will be clear that when the contact C is moved along the conductor AB the difference of electric resistance, and therefore of potential, between the points A and C will be varied, and consequently the extent of deflection of the needle or index of the galvanometer T may be controlled as desired, so as to cause said index to point to any scale division or other mark or marks inscribed along its path. Connected in multiple arc with the galvanometer T are the two conductors marked + and —. Obviously these conductors will also be affected by the movement of the traveling contact C along the line AB, and will assume a difference in potential depending on the position of C on AB; so that if galvanometers I be connected to these conductors in the manner shown in fig. 7, these galvanometers will respond to the movements of the contact C for the same reason as does the galvanometer T. Furthermore, if all the galvanometers T and I be exactly similar, the needle deflections in all will be the same, and thus any indication caused in the galvanometer T will be repeated in the galvanometers I. Therefore, if T be the transmitting galvanometer, and if the instruments I be located at distant stations, it is plain that an operator at T, by adjusting the traveling contact C, can produce in his instrument a deflection which will instantly be repeated and shown at the distant stations in the receiving galvanometers I. It will be apparent, however, that if the galvanometers I are differently located with respect to each other and to the galvanometer T, so that in the circuit of one there is a different resistance from that which is in the circuit of the others, or if from any cause any galvanometer becomes less sensitive, means must be provided whereby said galvanometer may be adjusted or regulated so as to compensate for any such differences or changes, or, in other words, so that each receiving galvanometer may be so regulated that its deflections or indications will correspond to those of the transmitting galvanometer T. In the practical construction of the system these means are

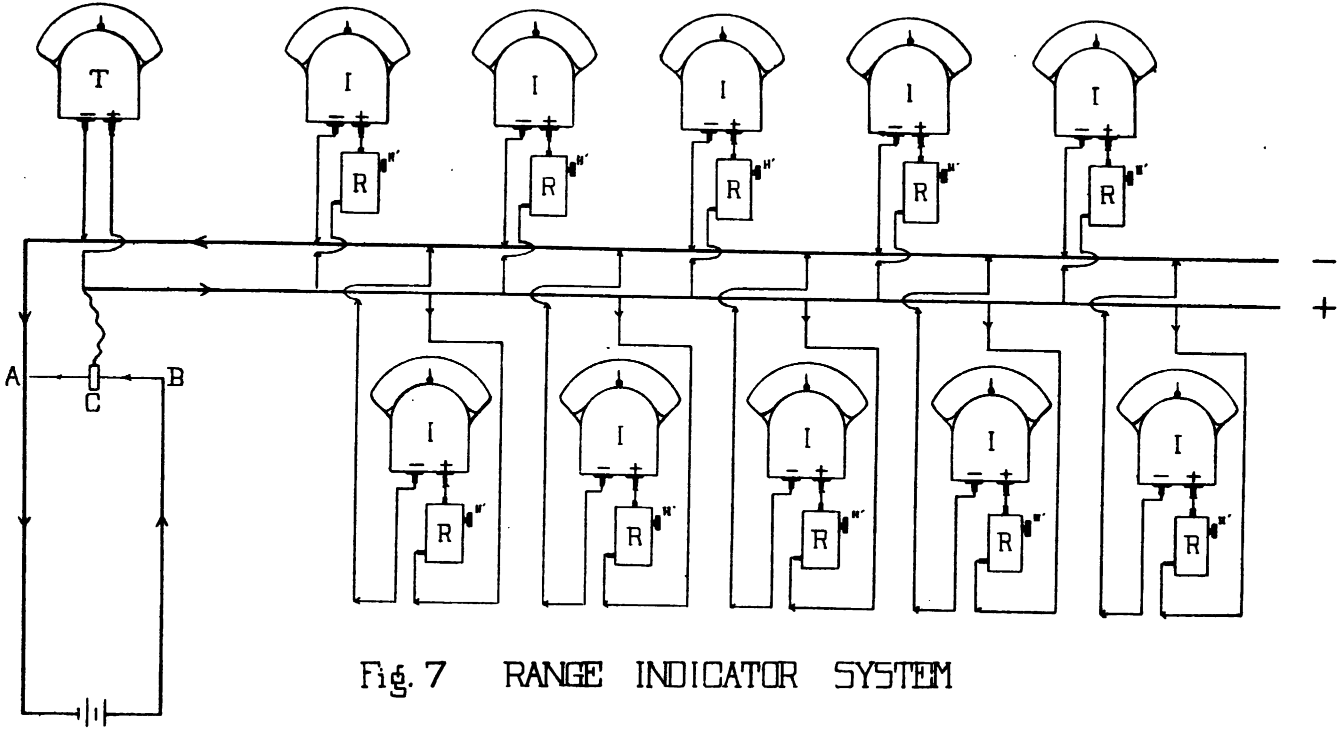


Fig. 7 RANGE INDICATOR SYSTEM

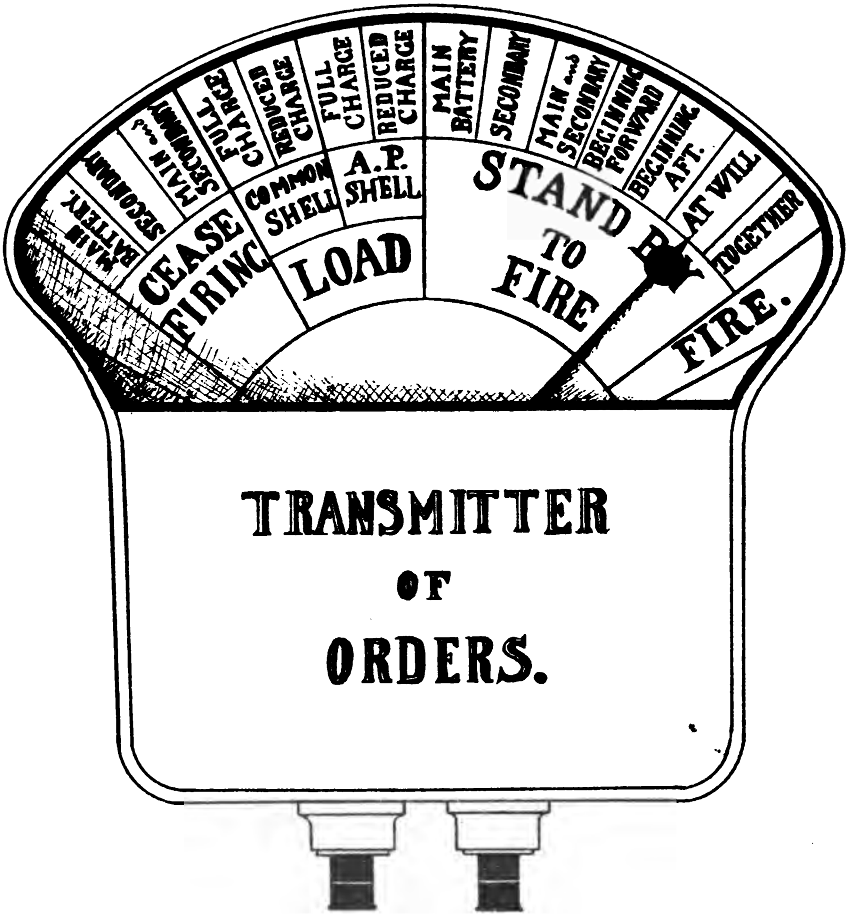

MAIN BATTERY.
SECONDARY
MAIN & SECONDARY
FULL CHARGE
REDUCED CHARGE
FULL CHARGE
REDUCED CHARGE
MAIN BATTERY
SECONDARY
MAIN & SECONDARY
BEGINNING FORWARD
BEGINNING AFT.
AT WILL
TOGETHER
CEASE FIRING
COMMON SHELL
A.P. SHELL
LOAD
STAND BY TO FIRE
FIRE.
TRANSMITTER OF ORDERS.

Fig. 9

provided, and consist merely of an adjustable resistance placed in series with each galvanometer, and secured in a water-tight iron box, R.

The place for the transmitter T is near the reading instrument of the range finder, so that any distance read from it can at once be made to appear on the transmitter and simultaneously on all the indicators in the ship. The transmitter should be horizontal.

To adjust the apparatus for use, connect the battery and make the transmitter read, say, 2,950, or any other preconcerted number. Then make each receiver read the same number by turning the thumb wheel H′. The apparatus is now ready; but if there is time, it is best to try a number of preconcerted numbers in succession. It is better not to use the even hundreds in adjusting, because the graduations halfway between them are finer and give better opportunities for exactness.

The transmitting and indicating galvanometers are all similar, so that in the event of accident to the transmitter a receiver can be substituted for it. If this is done, however, it will be necessary, of course, to verify the adjustment of the instruments in the manner above described.

The battery found most satisfactory for all this class of work is the "chloride" storage battery. It is extremely uniform in resistance and electro-motive force, and requires almost no care, provided it be connected to the electric-light circuit and charged once a week. To do this is very easy, as it only takes a little more trouble than is required to turn on an incandescent electric light.

Weight of each instrument complete, = 18 pounds.

Weight of two storage cells in box, = 40 pounds.

The instruments can be secured directly to a bulkhead. If desired, they can be graduated to work in a horizontal position.

The service trials held with these instruments in the U. S. S. *San Francisco* and U. S. S. *Cincinnati* have been satisfactory, and the system is being installed on a comprehensive scale in the battleship *Maine*, also the *Texas* and *Indiana*.

TRANSMITTERS OF ORDERS.

It has been suggested that the same system can be used to transmit orders to the turrets and other parts of the battery. It is merely necessary to have a similar circuit, in which the indicators are graduated as shown in fig. 9.

THE TELESCOPE SIGHT.

At 2,000 yards a ship of 20 feet freeboard subtends a vertical angle of less than one-fifth of a degree. The distance at which a gun captain stands behind his sights may be said to be about 120 inches from the front sight and 60 inches from the rear sight, so that this angle of one-fifth of a degree is represented on the front sight by about two-fifths of an inch and on the rear sight by about one-fifth of an inch. Now, in order to shoot correctly, the gun captain must fire so that the projectile will leave the gun just when the exact points of the two sights are in line with the target. It is not very easy to do this, as the records of gun practice at sea most sorrowfully prove.

A little reflection will show why correct firing is so difficult. In the first place, the construction of the ordinary bar sights is such that, except when the sights are on a level with the target in a vertical plane, it is extremely difficult to tell if they are pointed in the proper direction in a horizontal plane; and not only this, but when the ship is rolling away from the target the rear sight and the gun itself mask the target completely. In the second place, the line of sight sweeps over the entire vertical target in one-fifth of a second (supposing, as when considering electrical firing, that the ship is rolling 1 degree per second), so that the gun captain has only one-fifth of a second of time in which to make up his mind whether the sights are on the target and to fire if they are on the target. Now, the three objects which he is trying to get into line are the target, the front sight, and the rear sight, of which one is 2,000 yards distant, another 10 feet, and the other 5 feet; so that he is called upon instantly to focus his eye on three points at distances of 2,000 yards, 10 feet, and 5 feet, and the human eye is so constructed as to make this impossible. But the most formidable difficulty is that during the one-fifth of a second during which the gun captain must do the things above enumerated he must, in addition, have the pupil of his eye behind the rear sight in an exact line with the line prolonged from the front sight to the rear sight. If the pupil of his eye is not exactly on this line he cannot recognize the instant to fire, except approximately; and if his eye be as much as two-fifths of an inch above or below the line, and he fires when his front sight or his rear sight rests on the target, his gun will really be pointing 20 feet above or below the point of the target on which the sight rests. It is not an answer to point out the wonderfully fine shooting done by some men, because the records of target practice show that such shooting is, to say the least, exceptional. Now, a telescope of large field and small magnification has been found to practically eliminate all the errors of sighting, and to make it possible and easy for an ordinary man with hardly any practice at all to shoot fairly well always and badly never, as was proved before an official Board in the U. S. S. *San Francisco*, by the writer, using absolutely untrained men, including firemen and coalheavers.

The large clear field of view with the two cross wires, one vertical and the other horizontal, lets a gun captain see, even when the horizontal wire is far below or above the target, just how much the gun must be moved to the right or left; everything is exactly in focus, so that there is no strain on the eye whatever, and, which is the most important, the gun captain can not sight wrong even if he tries. He can not take a fine sight or a coarse sight or a bad sight. The cross hairs are either plainly on the target or plainly not on the target; and just so long as

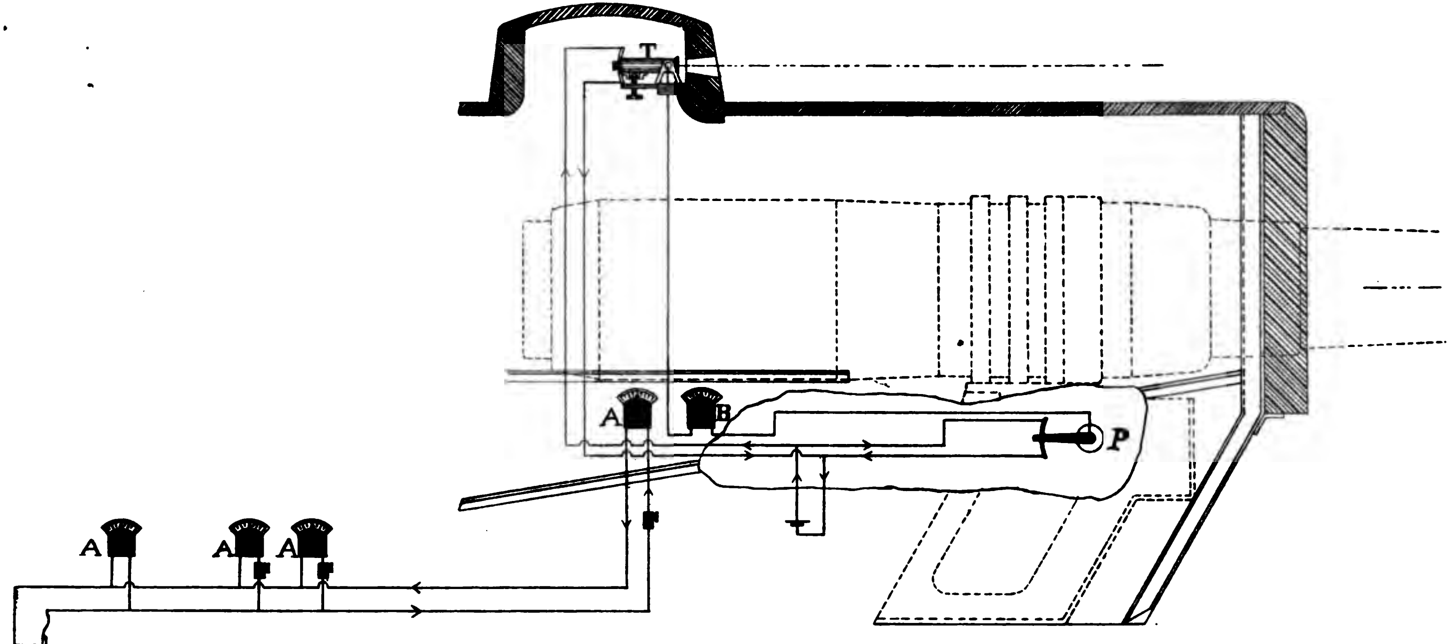


Fig. 10. GUN AND TURRET FITTED WITH ELECTRIC TELESCOPE SIGHT.

he looks through the telescope at all he can see the cross hairs in only one place, and that is in the fixed axis of collimation of the telescope. Since a telescope can be made to endure about as much rough usage as a football, it seems certain that telescope sights are the coming sights in modern ships. Of course they can not be used on the gun themselves, because the guns recoil, but they can be used in combination with some part of the gun support laterally moveable with the gun.

THE ELECTRIC SIGHT.

A ship which can adjust her gun sights quickly when the range is changing quickly will have a great tactical advantage over a ship which can not. It has been found in practice when the range is changing rapidly that the range finder and range indicator can measure and signal ranges so rapidly that it is almost impossible to set the sights and get ready to fire before a new range necessitates a new adjustment of the sight. To secure the tactical advantage to be obtained by meeting this difficulty an electric telescopic sight has been constructed to so work in cooperation with the range indicator that the setting of the sight will occupy but an instant and not interfere with the firing of the gun or distract the attention of the gun captain.

As shown in fig. 10, one of the receivers, A, of the range indicator circuit is placed alongside of a similar indicator, B, which shows the distance corresponding to the angle between the bore of the gun and the line of sight of the telescope T, which is placed in the sighting hood above the gun, the telescope T and arm P on the gun pivot being connected with B by arcs of resistance wire exactly as in the range finder. Evidently the telescope and the gun are converged at the correct angle when the indicators indicate the same distance.

The operation is as follows: The gun firer places his telescope at whatever position in the vertical plane he finds convenient. He does not need to know the range, except approximately. The elevator man watches both the range indicator A and the gun-elevation indicator B, and merely works the elevating mechanism so as to make the latter read the same as the former. When the gun firer sees his cross hairs rest on the target he presses the electric firing button. To prevent his firing when the indicators indicate differently the firing circuit is broken in two places, one place being his firing key and the other place being a similar key near the elevator man. The gun can not be fired unless both the elevator man and the gun firer press their keys; and neither presses his key unless he is ready. The elevator man keeps pressing his key so long as the two indicators, A and B, indicate the same thing; but if the range suddenly changes he releases his pressure on the key until by moving the elevator wheel he has made the gun-elevation indicator, B, indicate the correct distance; he does the same thing if the gun firer changes the position of his telescope and the indication of the gun-elevation indicator. It will be noticed that this operation on the part of the elevator man is a very simple one, since he merely has to move his wheel a fraction of a revolution in one way or the other to keep the needle of his indicator at the same mark as is the needle of the range indicator beside it.

On the base of the telescope sight are arrangements for correcting for speed and drift.

In the case of guns that recoil along the line of fire, especially with the smaller calibers, the telescope sight is attached directly to the support of the gun, which moves laterally and vertically with the gun, but does not recoil. Fig. 12 shows the field of view of the telescope sight which the writer mounted on the support of a rapid-fire gun on board the *Yorktown* in 1892, the gun being frequently fired to test the sight. Fig. 11 shows, in comparison and on the same scale, the field of view obtained when using the ordinary sights on a 6-inch gun, on the shield of which the sight was first tested in the same ship.

POSITION FINDERS.

While the appliances of modern warfare conspire to remove practical naval gunnery from the realms of chance to those of certainty, the art of coast defense is keeping pace, and is replying with every kind of thinkable device for increasing the rapidity and precision of fire of forts, i. e., for sinking attacking ships. Secured on firm emplacements, behind impenetrable walls the guns and mortars of modern fortresses present the highest example of the combination of tremendous strength with refined precision. For the large calibers, the use of disappearing guns is on the increase, the gun disappearing behind the parapet after firing, to get a new charge. In order that the gun may be exposed above the parapet as short a time as possible, it is elevated on its carriage in accordance with the range signaled and is trained in azimuth, according to the direction signaled, before it is raised to fire, so that as soon as it is raised it can be immediately fired, and then by the energy of the recoil forced back at once to the loading position. Now, the determining of this range and direction is the office of a position finder The simplest kind is the "depression position finder." Of this type there are a very great number on instruments in use in Europe, the most successful being that of Colonel Watkin, of which the English Government keeps the details a secret. In this country, that of Lieut. I N. Lewis, United States artillery, has proved extremely successful. It is not electric, however, and so a description would hardly belong here. The writer has endeavored to accomplish both the work of measuring and of signaling the results in instruments of this class by means similar to those employed in the range finder, in the manner hereinafter shown.

It may be pointed out here that if the position finder simply finds the distance and direction of the target from the position finder at a given instant, the people at the guns will not be benefited much, for two reasons, first, by the time that the gun can be gotten ready in

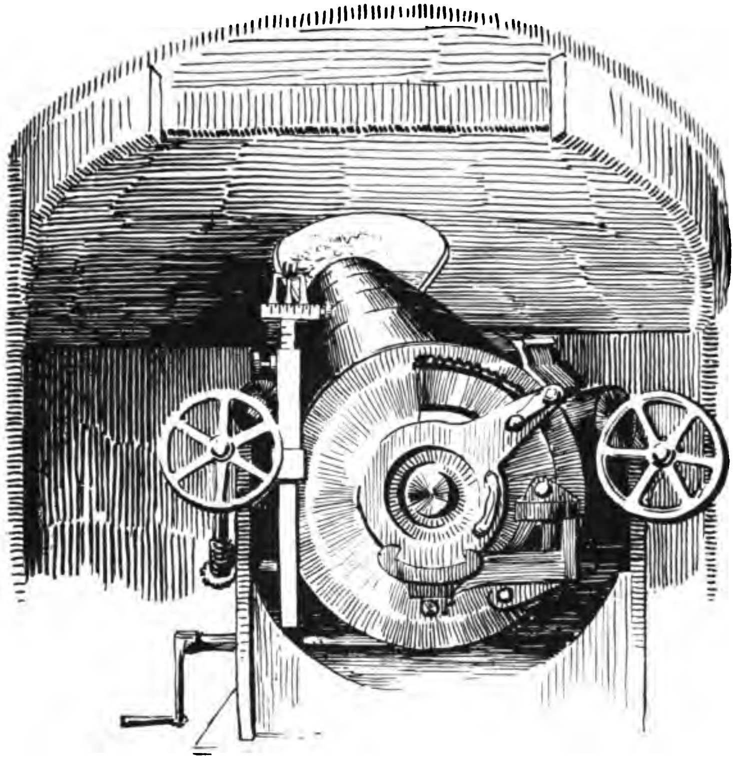


Fig. 11.—A BATTLE SHIP 300 FEET LONG, MASTS 150 FEET HIGH, SEEN OVER ORDINARY GUN SIGHT AND THROUGH PORT IN GUN SHIELD.

Horizontal field in gun port = 9.5°. Vertical field = 3°. Eye of gun captain being 60 inches behind rear sight. Ship is 2,000 yards distant.

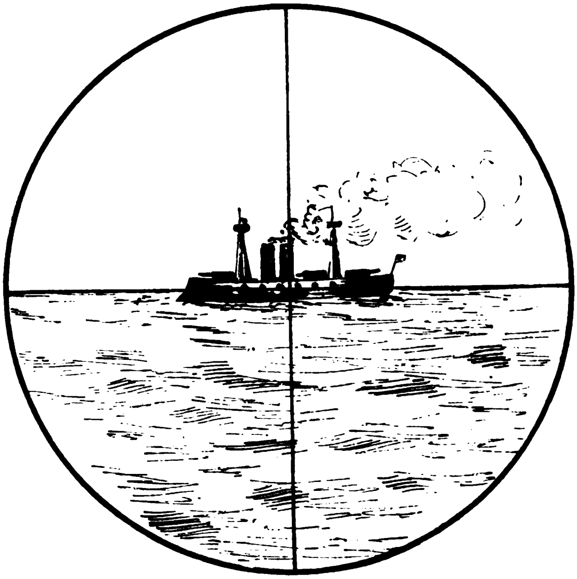


Fig. 12.—SAME SHIP SEEN, AT SAME DISTANCE, THROUGH TELESCOPIC GUN SIGHT.

Horizontal field = 8°. Vertical field 8°. Magnification, 4 diameters.

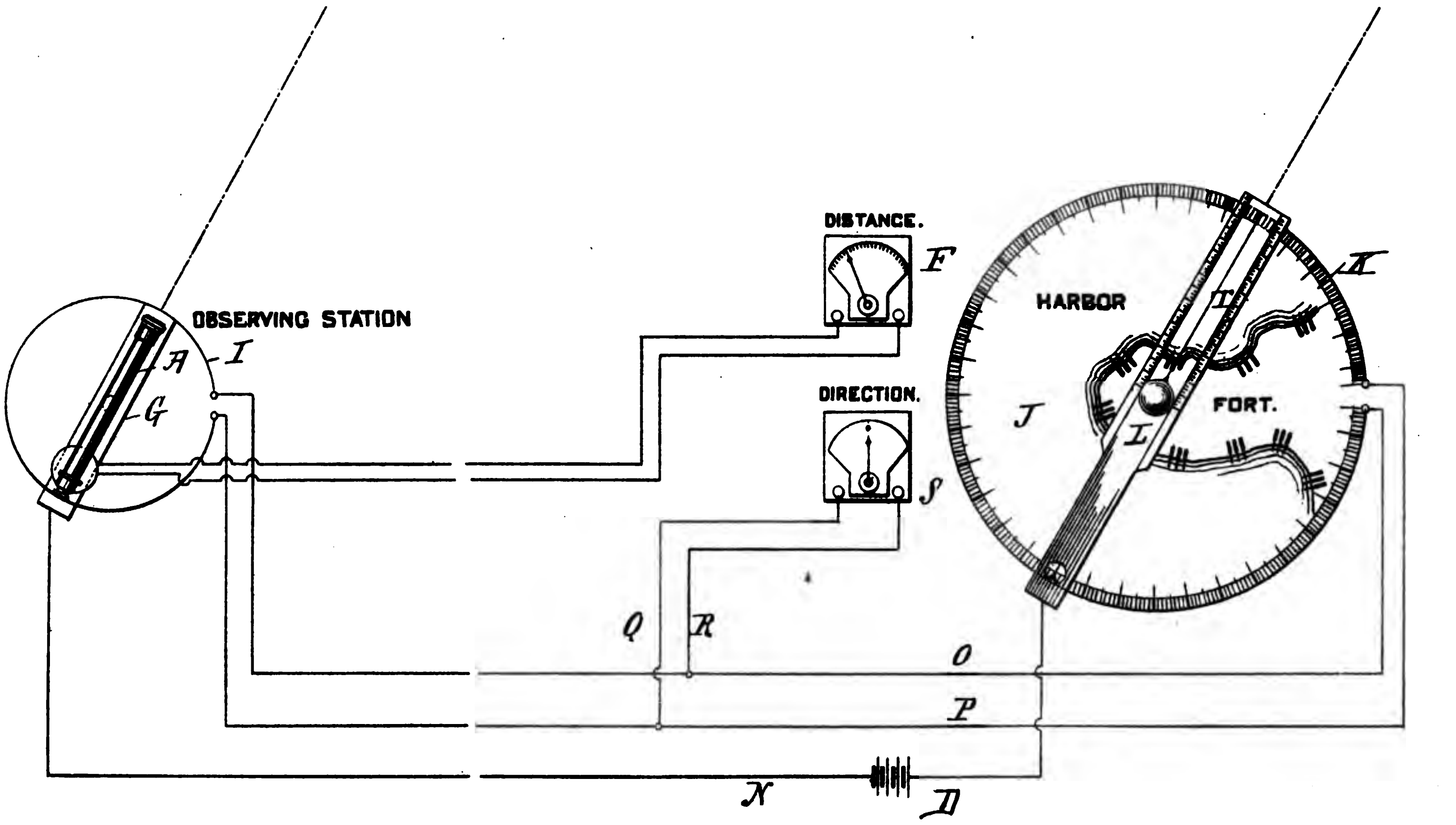


Fig. 13. POSITION FINDER.

accordance with any range and direction signaled the range and direction will have changed; second, the people at the guns want to know the distance and direction of the target from their guns and not from the position finder. To remedy the first difficulty the people at the position finder do not signal to the guns what the range and direction are at that instant, but they predict what they will be thirty seconds later, so that the gun people have thirty seconds in which to lay the gun. To enable the position-finder people to predict they take observations every thirty seconds, plot the exact position of the target each time on the plotting table of the position finder, and connect the various points by a line, more or less broken. A little practice enables them to thus lay down on the chart the exact track a ship is making. If the track shows that the ship has gone a certain distance in a certain direction in a certain time, it is not hard to prolong the track line so as to show where she will be in thirty seconds more; in other words, to "predict her position." It is this predicted position that is signaled to the guns. When the ship arrives at or sufficiently near the predicted position, the signal is sent to the guns to fire. Of course if during the interval the ship suddenly changes her course and speed very greatly, she will not reach the predicted position at exactly the end of thirty seconds. But a heavy ship can not alter her course and speed so much in thirty seconds as to throw out the predicted position much, as even a rough calculation will show, especially if she is in company with other ships in a channel; and even if she could, it would be simply necessary to hold the fire until a new position were determined, which would be a matter of a few seconds only. The manner of using the position finder can be best shown by an extract from the official report on one placed at Spezia, Italy.

> The disposition of the Fiske position finder renders it possible to make rapidly a series of observations upon a target in motion, and to solve the problem of how she is going; to determine the route, the radius of the circle of turning, the speed, etc. During the recent trial at Spezia, the base line of the position finder being 104 meters long, there was determined the velocity of a torpedo boat, which was going at a speed of 8 knots, of 10 knots, of 12 knots, maintaining a distance from the position finder ranging from 2,000 meters to 5,000 meters. There was determined at regular intervals the different points of her track, and the resulting speed deduced varied from the speed obtained on board the vessel itself by only 3 per cent. In order to give an idea of the quickness with which it is possible to fix the ship's position, and after the observers have had a certain amount of practice, it is sufficient to cite the fact that while the torpedo boat was making a complete circle of 250 meters diameter, at a speed of 10.5 knots, the average distance from the position finder being 1,500 meters, there were plotted 11 successive positions. In another trial, while the boat was making a circle of 350 meters diameter, at a distance of 2,500 meters from the position finder, at the same speed, her position was plotted 17 times.

The position finder having determined the range and direction of the target from itself, it remains for the people at each gun to determine what are the range and direction from that gun. This may be done by means of tables of figures, which show for each gun what are the directions and ranges from that gun of every position that can be signaled from the position finder. But a speedier plan is offered by the instrument invented by Lieutenant Rafferty, United States artillery, called a "relocator," in which the conversion from one system of coordinates to the other is done mechanically. The instrument is extremely simple in construction, and (which is more important) is simple in operation, but not being electrical its description hardly belongs here.

DEPRESSION POSITION FINDER.

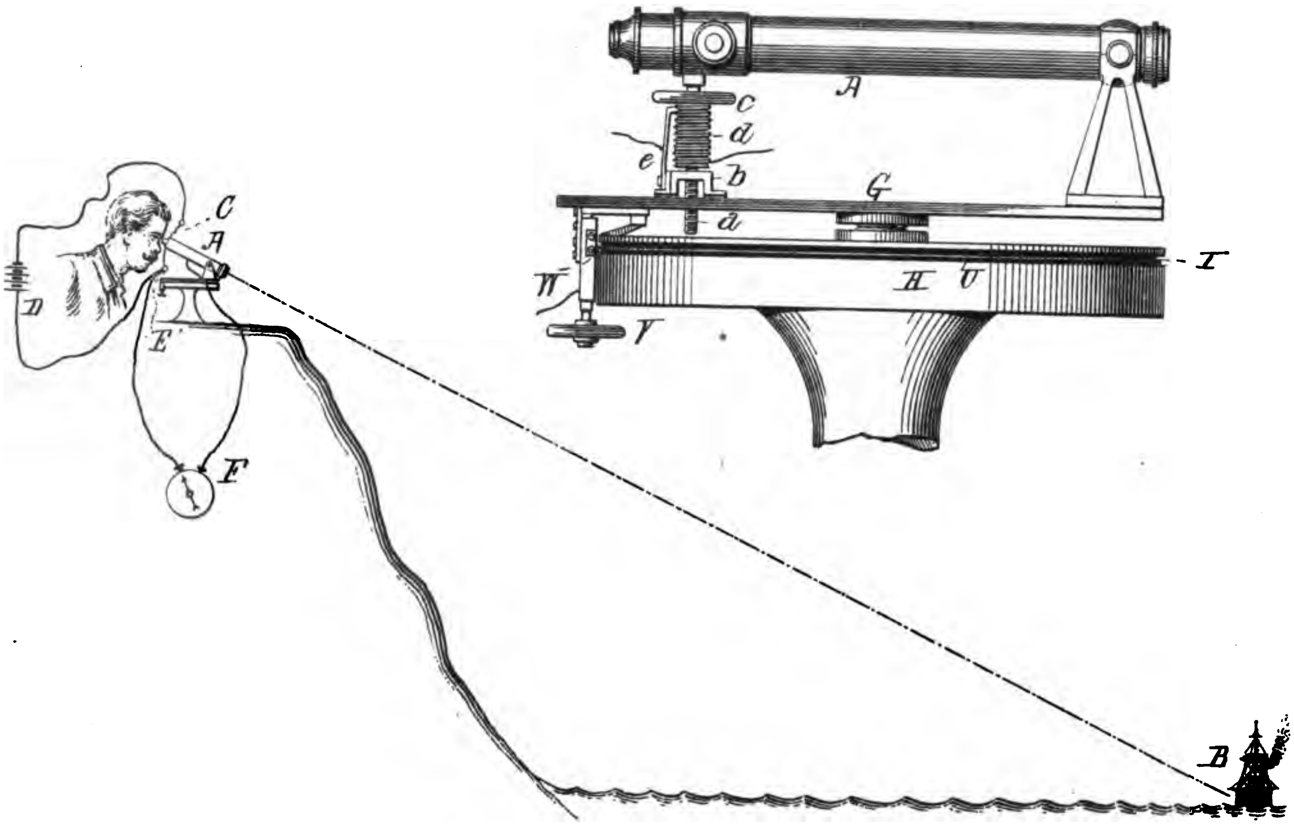
When the ground in the vicinity of the water is high, the distance of a vessel on the water can be found very simply by mounting a telescope on an eminence, pointing it at the vessel's water line, and noting the angle of depression of the telescope below the horizontal. The height being known, the distance is inversely proportional to the sine of this angle, so that the instrument may be graduated at once in yards. The direction is obtained with equal simplicity, by noting the azimuth of the telescope, as shown on a horizontal circle. To make these measurements and send them to the guns automatically is the office of the instrument hereinafter described. Corrections are, of course, needed for the rise and fall of the tide and for changes in refraction. The special limitation of this class of apparatus is the fact that the smoke of guns frequently hides a vessel's water line altogether, as was conspicuously shown at the battle off the Yalu.

The apparatus consists in two principal parts, namely, a device for determining the distance and a device for determining the direction or bearing of the object. The said two parts are used conjointly, and thereby the location of the object may be recognized upon a chart representing the area of the harbor, for example, drawn on a reduced scale.

In the accompanying drawings, fig. 14 is a diagram illustrating the operation of the distance or range finder. Fig. 13 is a diagram illustrating the operation both of the range finder and of that part of the apparatus which shows the bearing of the distant object. Fig. 15 is a side elevation of the observer's instrument and shows the mechanism thereof on a larger scale and in detail.

Similar letters of reference indicate like parts.

Referring first to fig. 14, A is a telescope, sight bar, or other like means of directing the line of sight, indicated by the dotted line upon the object B. This telescope is to be located upon an elevation adjacent to the waterway to be protected. The telescope is pivoted at its outer end, so that it can be depressed through any desired angle in order to bring it to bear upon the object. The telescope is provided near its sight end with a contact piece or wiper which always bears upon a body of conducting material, represented symbolically at C, fig. 2. Connected with the ends of the body C is a voltaic battery, D, and connected in circuit with one end, E, of the body C and with the movable wiper or contact



Figs. 14 and 15. POSITION FINDER.

piece carried by the telescope A is a galvanometer, F. It will be apparent that as the telescope A is moved on its pivot its contact piece or wiper will be carried along the body C, and, as a consequence, a greater or less amount of the body C will be brought into the circuit which includes the galvanometer F. Inasmuch as the body C is to be constructed of, for example, a wire of uniform resistance per unit of length, it is obvious that as the telescope A is moved and a greater or less length of said wire is brought into the galvanometer circuit the resistance thus interposed in said circuit will be increased or diminished; and as this length, and hence this resistance, depends upon the angle of depression of the telescope, it becomes a function of the angle of depression; and, equally, the deflection of the galvanometer F, due to this change, is also a function of the angle of depression. Therefore, knowing the height of the telescope above the level of the object, the galvanometer deflection will indicate the distance of the object from the telescope, for which purpose the galvanometer may be once for all graduated in any suitable unit, such as meters or yards. Hence, if the galvanometer be located at a station distant from that telescope, an observer at that distant station, by reading the galvanometer, can recognize at once the distance of the object, while the person stationed at the telescope has nothing to do but to keep it properly directed upon the object.

The telescope pivot is carried upon a bar, G, fig. 15, which is pivoted upon a circular table, H. Placed in a groove around the periphery of this table is a wire, I, fig. 13, of conducting material, having a uniform resistance per unit of length. Upon the bar G is supported a contact piece or wiper, as will be more particularly explained hereinafter with reference to fig. 15, which contact piece or wiper always bears upon the wire I. At the distant station, fig. 13, there may be arranged a circular table, J, having around its periphery a wire, K, similar in all respects to the wire I. Upon the table J is pivoted a bar, L, which bar L carries a wiper or contact point which constantly presses upon the wire K. The contact point on the bar G and the contact point on the bar L are connected by a wire, N, which also includes the battery D. The ends of the wires K and I are connected by wires O and P, and said wires O and P are respectively connected to wires Q and R, which lead to the terminals of a galvanometer, S. It will be obvious, by a simple inspection of the drawing, fig. 1, that the wires I and K at the separated stations and the pivoted bars G and L, together with the battery and the galvanometer S, are connected in Wheatstone bridge circuit, and that a movement of either the bar L or the bar G, displacing the contact pieces over the wires K or I, will vary the resistance of the bridge arms so that the bridge may be brought into or out of equilibrium by the movement of these bars upon their pivots; and further, it will be obvious that the fact when equilibrium is produced in the bridge will be made manifest by the movement of the pointer of the galvanometer S. The construction is to be such, therefore, and the instruments at the separated stations are to be placed with reference to one another, so that when the bar L makes the same azimuth angle with reference to one end of its wire K as does the bar G, then the bridge will balance and the galvanometer S will show zero; so that if the telescope A, and consequently the bar G, parallel thereto, be directed upon the object, the galvanometer S will indicate zero when the bar L is placed similarly to the bar G. If then, on the table J there be disposed a chart of the area to be protected on a reduced scale, such, for example, as is shown in fig. 1, the direction of the object from the point of observation will be indicated by the position of the bar L. For convenience in this respect the bar L is made with an opening containing a longitudinal wire, T; the position of the object on the chart being of course along this wire; also on the sides of the opening in the bar L may be marked a scale of distances, in yards or meters.

The operation of the whole apparatus is therefore as follows: The telescope A is depressed, and also moved in azimuth, until aligned with the object. Inasmuch as the distance of the object depends, as has already been explained, upon the angle of depression, and as this angle is measured by the galvanometer F in terms of distance, it is plain that if the galvanometer F be located at the station distant from the observer, then from that instrument the distance of the object can at once be read off. Simultaneously the movement of the telescope A in azimuth disturbs the balance of the bridge which includes the galvanometer S. The observer at the distant station then moves the bar L until the galvanometer S, placed near to him, shows zero. When this is done, the position of the object will be somewhere along the line of the wire T; and its exact point along that wire T is immediately found by noting on the scale on the bar L the distance corresponding to that shown by the galvanometer F. The bearing and distance of the object thus being ascertained, it remains simply to communicate this information, by any suitable means, to the guns or battery.

It will be apparent that one of the advantages of this instrument is that it is directed by a single observer, and that the simple operation of aligning it with the target instantly causes, at the distant station (the bar L there being suitably manipulated), indications from which the bearing and distance of the object may at once be recognized.

Referring now to fig. 15, there is here illustrated, in detail, the mechanical construction of the telescope A and its supports. The table H may be of any suitable material, and should have embedded in it a ring, U, of hard rubber or other insulating material, in which ring is the groove in which is placed the wire I. The bar G is conveniently rotated on its pivot by means of the hand wheel V, the support for which wheel carries the contact point or wiper W. The inner end of the telescope A is supported on the vertical screw *a*, which passes through the fixed nut *b* which is carried on, but insulated from, the bar

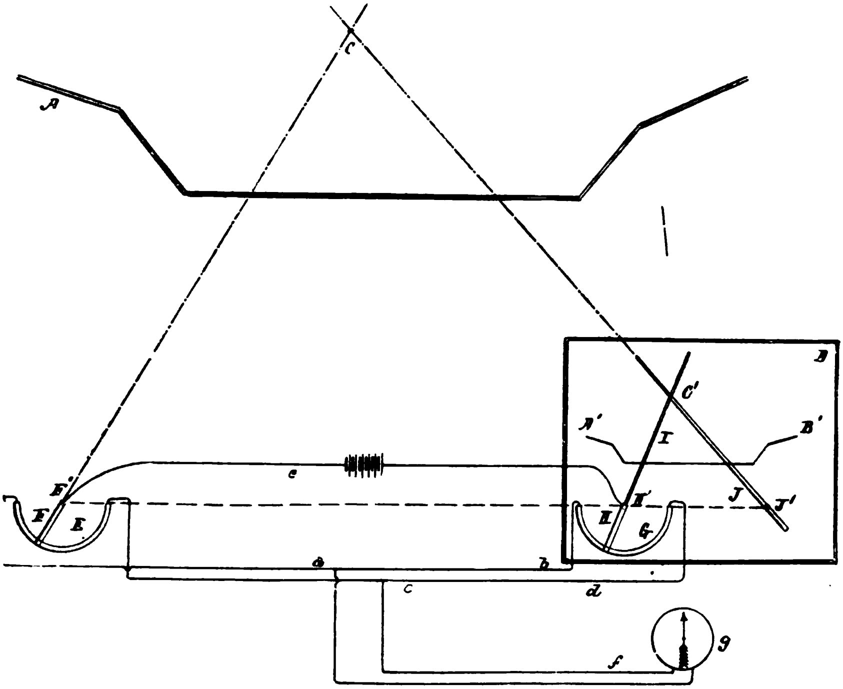


Fig. 16.—POSITION FINDER.

G, the insulation being placed below the nut. The screw *a* is rotated to depress and lower the telescope by means of the hand wheel *c*. Secured upon the screw is a cylinder, *d*, of ebonite, having upon its surface a spiral groove in which is laid the German silver wire corresponding to the body C, fig. 2. *e* is a contact spring which always bears upon the wire C, and this spring is supported upon, but insulated from, the nut *b*. In this device, instead of causing the telescope A to carry the contact and move it over a fixed body, C, as in fig. 10, the body C, by the rotation of the screw *a*, is made to move under the fixed contact piece *e;* the relation of the parts being thus merely reversed. The circuit connections are the same as is indicated in fig. 1; that is to say, the battery terminals lead to both ends of the wire C wrapped upon the cylinder *d*, and the terminals of galvanometer F connect respectively with the contact wiper *e* and one end of the wire C. The movement of the telescope A in azimuth is three hundred and fifty degrees.

HORIZONTAL BASE POSITION FINDER.

If the ground in the vicinity of the water is not high enough to offer a sufficiently long vertical base line for a depression position finder, it becomes necessary to use a horizontal base. The solution of the problem of so employing a horizontal base has been attempted during many years, but, so far as the writer has been able to ascertain, the only system that has done it successfully is the one here described, in which telescopes located at the opposite ends of a base line carry contacts which sweep over arcs of wire that are connected together in the same way as in the range finder just described. The position finder referred to in the Italian report, of which an extract has just been given, is of this character. Another form is shown diagrammatically in fig. 16, in which—

A B represents the parapet of a fortification. The distant object is supposed to be located at C, and it is the position of this object which is to be determined upon a suitable chart, D, on which the fortification line A′ B′ appears on a reduced scale.

E is an arc of conducting material.

F is a telescope or alidade arm pivoted at one end at F′, with its free extremity moving over and making contact with the arc E.

G is an arc similar in all respects to the arc E and located in su[illegible] proximity to the chart D.

H is an arm pivoted at H′ and having its free end sweeping over and making contact with the arc G and carrying a pointer, I.

a b c d are members of a Wheatstone bridge connecting the arcs E and G.

e is a loop including the battery, and *f* the loop including the galvanometer *g*.

It will be obvious that when the arm H is set upon its arc G at the same angle to the line H′ F′ as the arm F upon the arc E, then the bridge will balance, and the galvanometer will indicate zero, and hence, inasmuch as the telescope F points to the actual object C, the arm H will point to the corresponding position of the object C or C′ on the chart D. Pivoted upon the chart D at J′ is an arm, J, which arm may be provided with a telescope or alidade so that it may be directed upon the object C. The arm J is long enough to make intersection with the arm I. If then the arm J is trained directly on the object, inasmuch as the line H′ J′ joining the pivots of the arms I J on the chart D corresponds to the base line F′ J extending between the distant stations, and as the angle C′ H′ J′ equals the angle C F′ J′, it follows that the intersection of the arms I and J at C′ indicates the position of the object C upon the chart D. The chart being drawn to scale, it is easy to recognize at a glance both the direction and the distance of the object C.

The latest form of this position finder is that installed at Fort Hamilton, and represented in figs. 17, 18, and 19. The larger of the instruments is fitted with a plotting table as well as a telescope.

The resistance wire for each instrument is wrapped in a spiral around an insulating cylinder instead of being laid in the form of an arc, and differs from the new form of range finder principally in the addition of the plotting table. The operation of using it is much the same as the operation of using the earlier form of position finder just described. The observers point their telescopes so that the cross wires rest on the mast or funnel of the enemy's ship above the smoke. The reader at the plotting table, usually an officer, keeps moving the electrical contact of his instrument so as to keep the galvanometer needle always at zero, thus maintaining the corresponding pointer always in parallelism with the telescope at the distant station. The reader and the observers have telephone receivers on their heads and long-distance transmitters on the telescopes, so that they are in constant communication. As soon as each observation is made the officer orders "rest," and both observers cease observing for a while. At the end of twenty seconds the officer orders "mark." The observers again sight their telescopes on the target and keep the cross hairs exactly on the mast until the officer, at the end of ten seconds, again orders "rest." The officer now notes the intersection of the pointers and marks it on the chart by a spring pencil, connects it to the position just preceding by a short line, and prolongs this line to an equal distance beyond the last point. The end of this line is clearly the position which the ship will probably occupy at the end of the next thirty seconds, and it is this "predicted position" which is signaled to the guns.

With a little practice the work of plotting and predicting positions occupies but a few seconds. To facilitate the operation, the apparatus has been given the form shown in figs. 17, 18, and 19. The pointers are heavy steel bars graduated every 10 yards up to 10,000 yards and supported at their outer ends on light brass rollers. The spring pencil fits

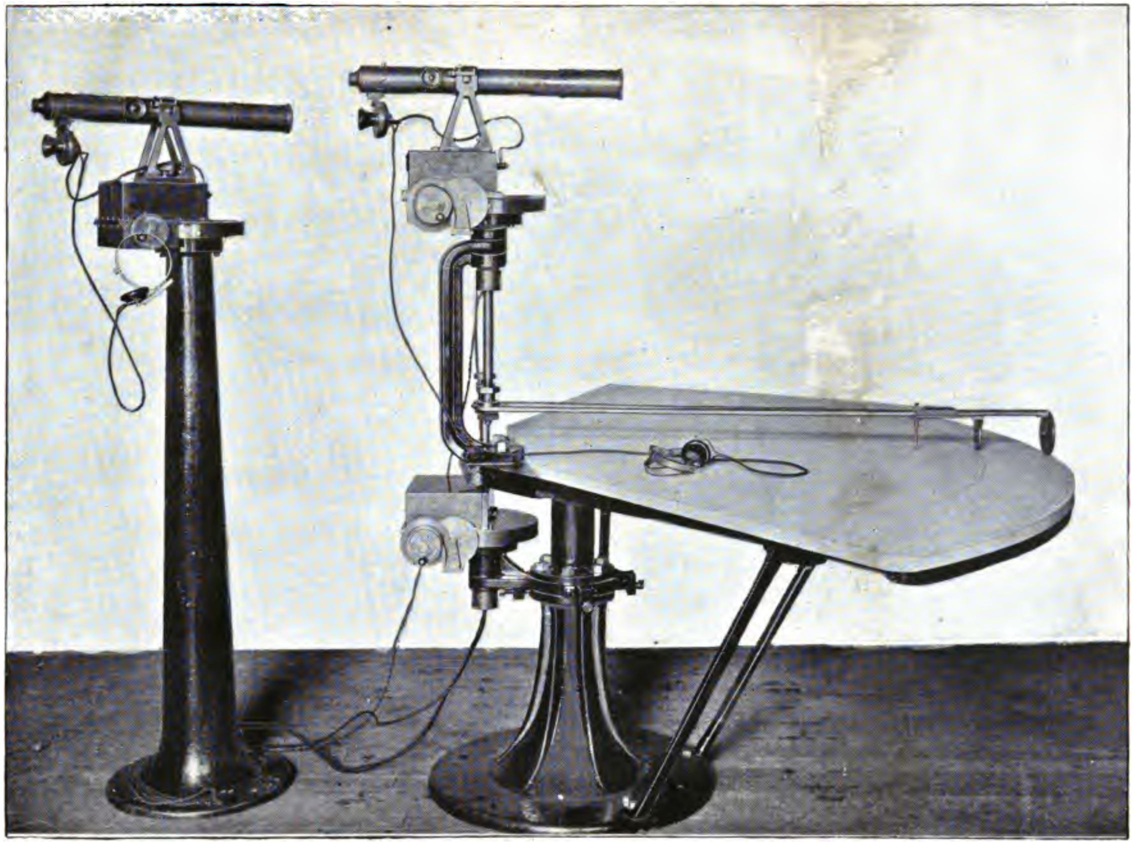


Fig. 17.—POSITION FINDER.

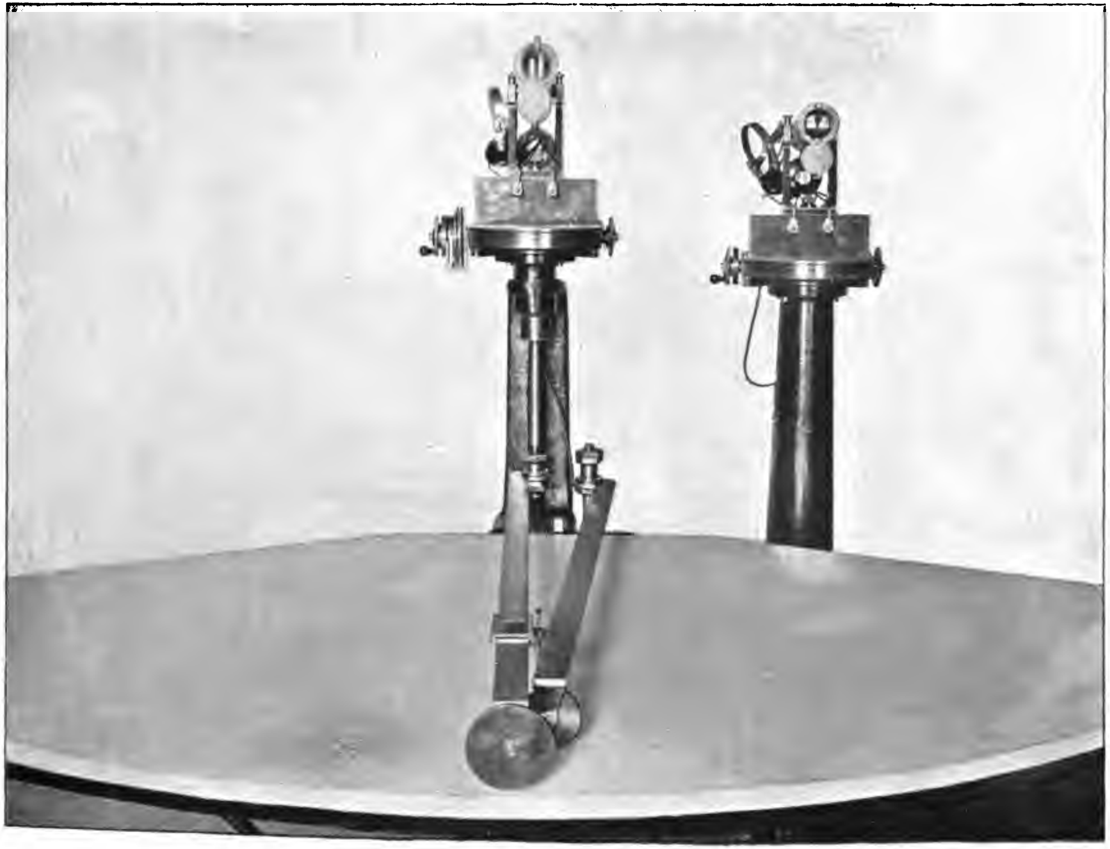


Fig. 18.—POSITION FINDER.

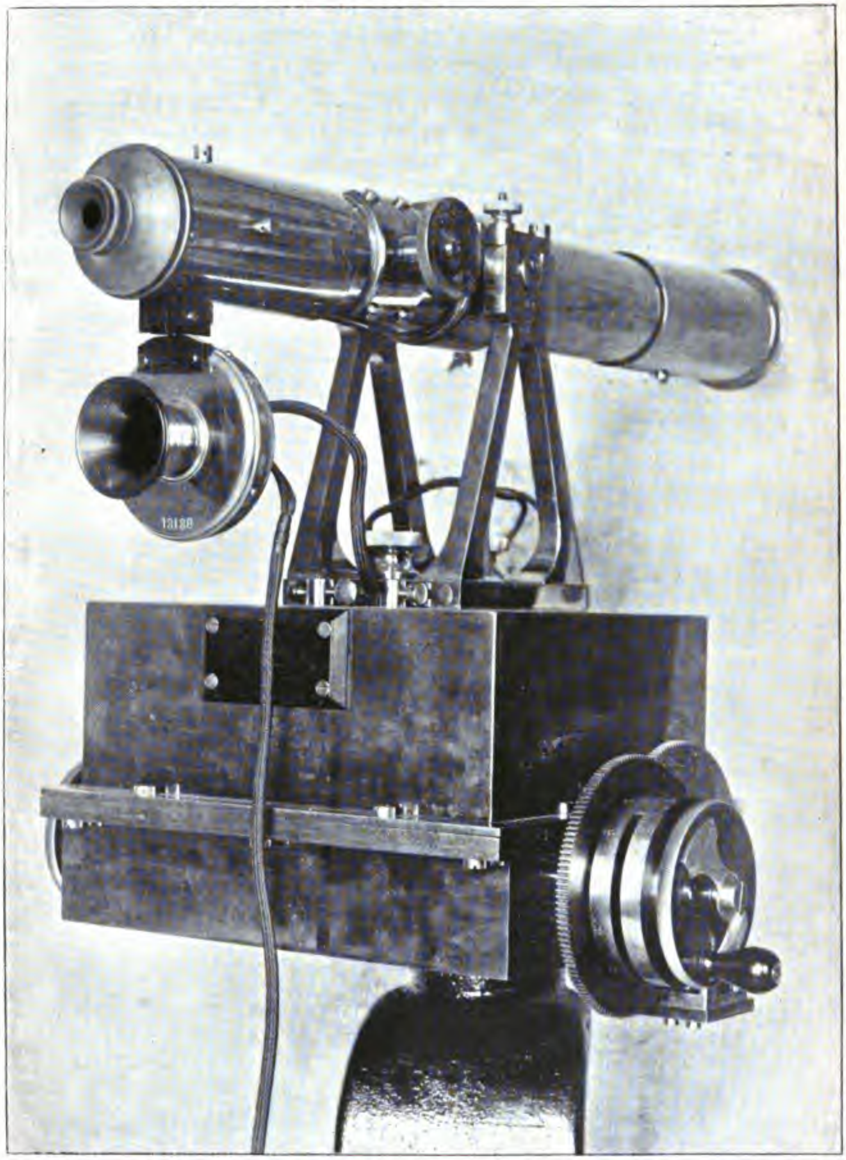


Fig. 19.—POSITION FINDER.

in a slider that moves along one of the pointers. When the slider is pushed along its pointer until its edge rests against the other pointer, the middle of the spring pencil is exactly at the point of intersection of two lines drawn from the centers of the pivots of the pointers; so that to mark the position on the chart of the enemy upon whom the telescopes are directed it is merely necessary to push down the spring pencil with the finger. The distance of the position from this instrument can be read at once from the graduated pointer through an opening in the slider, and the direction can be read at once from the graduated disks shown on the right of fig. 19.

As installed at Fort Hamilton, the base line is 985 yards. In plotting the positions of known objects situated in different parts of the lower bay, some as distant as 9,000 yards, no error as great as 1 per cent was discovered on the official or the preliminary trials.

V.

ON WATER-TUBE BOILERS.

By Monsieur J. A. Normand.

[Read at the thirty-sixth session of the Institution of Naval Architects, June 13, 1895.]

Water-tube boilers are inferior to the ordinary marine type in this, that any damage to one single tube necessitates drawing the fires and emptying the boiler. However, on account of their immense advantages as regards lightness and capability of supporting intense firing, when properly designed, they may certainly be called the boilers of the future.

ON SOME NECESSARY CONDITIONS FOR RESISTING INTENSE FIRING.

The intensity of firing in water-tube boilers is limited by the formation of "steam chambers," or stationary steam, in the heating tubes, and by the strains due to the expansion of these tubes. The temperature of a heating surface, behind which only steam exists, rises to such an extent that it rapidly becomes oxidized externally by the hot gases, which are always mixed with oxygen, and internally by the steam. Moreover, the strength of the metal when thus overheated is reduced, so as to render rupture probable. The formation of those "steam chambers" may be prevented by the following means:

(*a*) The direction of the tubes, especially in their lower and more heated part, must be as vertical as possible.

(*b*) The circulation must be very active.

(*c*) The proportion of length to diameter in the heating tubes ought not to be too large.

(*d*) The section of the outside down-take or water-return tubes, from the upper to the lower reservoirs, ought to be of large proportions.

In order to prove the above propositions, I shall consider (fig. 1) the two older arrangements of the Du Temple boiler. Commandant Du Temple was the first to apply to steam boilers that most important principle of the return of water outside the fire, perhaps the greatest improvement for the last thirty or forty years.

The oldest form of large boilers is shown in A, and the second one in B. For the sake of clearness, only one tube is shown in both designs; but it is important to state that, the length of tubes in B being one-half the length of those in A, their number is doubled, the heating surface remaining the same in both cases. The arrangement B was applied for the first time, at my request, in the torpedo boats *Lancier* and *Pernov*.

(*a*) The direction of the tubes, especially in their lower and more heated part, must be as vertical as possible.

An intense heat applied to the parts *m m'*, nearest to the fire, produces steam which may take two courses, viz, rise to the upper reservoir or go down in the lower one; it can also divide and go both ways.

In the first case, although the rise of water in the more vertical parts *n n'* produces an energetic circulation, the resistance to an upward motion is very great on account of the length of the tube. In the second case, the distance and resistance to overcome is very small, the more so as the pressure in the lower reservoir is always less than in the upper one, but the inclination of the tube opposes this course.

It is clear that with very slow firing the motion will take place in the right direction; but if sufficient heat is applied steam is produced in abundance, and part of the steam will pass to the upper and part to the lower reservoirs, interrupting the circulation and allowing the tube to become empty and red hot. When the boat heels the phenomenon will take place soonest on the side where the tubes approach more nearly to the horizontal.

In arrangement B, where the angle with the horizon of that part of the tube considered is much greater (about three times), the bubbles of steam rise much more easily, drawing the water with them, the more so as the tube in arrangement B is only half the length of the tube in arrangement A.

It must be borne in mind that steam bubbles do not rise easily in a slightly inclined tube, even when the inside surface is quite smooth, which is seldom the case, even with steel, which is the only reliable material,* especially after the tubes have been some time in service. To insure an easy rising of the bubbles a greater angle is necessary. This is especially important at the lower part of the tube, where the water enters and the heat is greatest. The most important thing is to set the water in motion in the right direction.

Mr. Thornycroft has shown that in the upper part of the tubes this rule could be dispensed with (it is evident that the tumble-down shape of the upper part of the Thornycroft tubes would never do in the lower part).†

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*Copper would certainly last much longer, but it is very dangerous, as in case of bursting the tube opens out fully, allowing the hot water and steam to escape through double the section of the tube. Ordinary brass becomes brittle and weak when overheated. With mild steel the section of the orifice is generally small. Security against personal injuries surpasses all other considerations in importance.

†*See* fig. 20, p. 254, General Information Series No. XIII.

For many reasons I greatly prefer that the shape of the tubes should be always rising through its whole length, but I would be the last to deny that the Thornycroft boilers have done and are doing good service, and that they have had a great influence on the development of water-tube boilers.

To return to the Du Temple boilers, experience has repeatedly shown the superiority of arrangement B over the other one. The actual design patented under the name of "Du Temple-Normand," which is different from "Normand's" boiler,* is still better.

(*b*) The circulation must be very active.

This is nearly self-evident. The greater the circulation the cooler are the tubes.

It is well known, moreover, how favorable is the agitation of water to the transmission of heat. Laboratory experiments have shown that the coefficient of transmission varies from one to five, according as the motion of water is nil or very great.

Increase in the economic duty of the boiler means easier firing.

(*c*) The proportion of length to diameter in the heating tubes ought not to be too large.

Within the ordinary limits of the ratio of length to diameter the resistance to the motion of water is nearly proportional to this ratio. The circulation of water, so essential to the good working of a boiler, is reduced as the resistance increases. Moreover, all the steam generated in the inferior part of the tube must pass through the upper end. The longer the tube the smaller the density of the fluid in the upper part, and the greater the chances of its being burned.

(*d*) The section of the outside down-take or water-return tubes, from the upper to the lower reservoirs, ought to be of large proportions.

When the boiler is at work, the pressure in the inferior reservoir is always less than in the upper one. Should it be otherwise, the water would not flow down by the return tubes. It is most probable that the steam generated in the heating tubes (or the air mixed with the feed) produces the circulation of water by impulse only. This force of impulse is so great that when the tube is vertical the ascending motion of the fluid may be estimated by applying the theory of communicating vessels, according to the difference between the mean density of the heterogeneous fluid in the heating tube and that of the water in the return tubes, due allowance being made, of course, for friction.

When the heating tube is more or less inclined, the adherence of bubbles to the inside surface is such that this mode of reckoning would certainly give a much higher speed than is actually the case, the error being greater as the inclination of the tube approaches the horizontal. This affords another proof of the importance of verticality in heating tubes.

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* *See* p. 26, No. XIII.

Should the soundness of these views be questioned, one thing, however, is indisputable—the rise of water and steam in the heating tubes produces a difference of pressure between the upper and lower reservoirs, and this difference reduces the intensity of the circulation from which it is a consequence. Accordingly, it is most important to lessen this difference in giving to the return tubes the greatest possible section.

In a paper read last year at the Southampton meeting, Mr. Thornycroft described some very interesting trials made on two boilers, differing only in this, that in one of them the heating tubes rose above the level of the water in the upper reservoir, whereas in the other one the upper end of the tubes were under water. The difference of pressure between the upper and lower reservoir was found to be greater in the second than in the first case.* The great engineer of Chiswick concluded from this fact that, since the difference of pressure reduces the circulation (which is quite undeniable), the circulation is greater with tubes rising above the water level. With all due deference, may I be allowed to state that I draw from these trials entirely opposite conclusions.

The dimensions of the outside return tubes being similar in both cases, and admitting that the total return of water takes place by these tubes, and not partially through some of heating tubes less exposed to the fire (which does not seem to be a very reliable arrangement), it is clear that the quantity of water which goes down through the return tubes will be proportional to the square root of the difference of pressure between both reservoirs. Now, this quantity of water is, by hypothesis, exactly equal to the ascending water, so that it is, according to the trials, greater in the boiler where the upper end of the tubes is under water. This conclusion is in accordance with the following probable theory, that the head of water which causes the circulation in a tube rising above water must be reduced by a height equal to that of the tube above the water level, due allowance being made for the smaller density of the fluid. The under-water arrangement does not, perhaps, allow of so great a heating surface for a given incumbrance; but it offers the further advantage that no "steam chamber" can exist in the upper part of the tubes.

ON STRAINS DUE TO THE EXPANSION OF HEATING TUBES.

The second cause which limits the intensity of firing is the strains due to the expansion of the heating tubes. Several well-known arrangements prevent these strains. For instance, that of the Belleville boilers,† the use of Field tubes as in the Collet-Niclausse boilers,‡ and especially the adoption of heating tubes sufficiently long and sufficiently curved (both conditions are necessary) for preventing oblique strains on the junction with the tube plates. It is also most important that no joints or riveting should be allowed in the actual vicinity of the furnace.

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* *See* p. 255, No. XIII.

† *See* p. 237, No. XIII.

‡ *See* fig. 32, p. 262, No. XIII.

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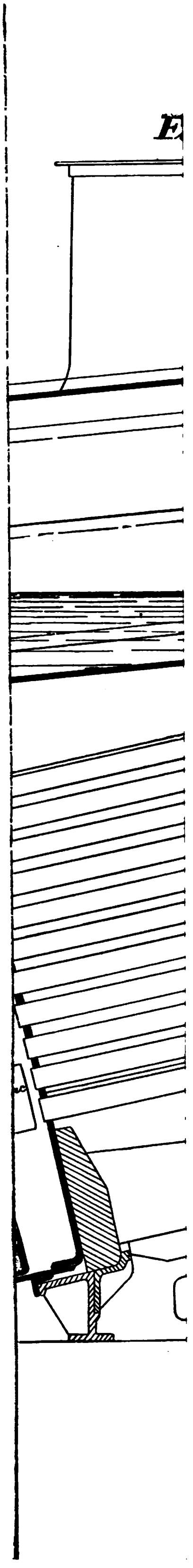

ON THE INFLUENCE OF ACTIVE CIRCULATION ON THE TRANSMISSION OF HEAT.

I have alluded already to laboratory experiments according to which the coefficient of the transmission of heat varies from one to five, according as the water to be heated is quite stationary or in rapid motion. Particulars may be found in the Traité de Physique industrielle, by Ser, Vol. I, page 225, etc. This is easily accounted for by this fact, that water is a very bad conductor of heat, and can be heated only by putting all the particles successively in contact with the heating surface.

Although the actual conditions of a boiler are very different from those of the experiments, especially as regards the temperature of the heating fluid, it is not less true that active circulation in boilers is most favorable to vaporization. This explains how the advantage to be derived from the use of feed heaters is always superior to that which results from the economy in the units of heat saved. This is especially to be noticed with Mr. Kirkaldy's feed heater. In this apparatus, steam taken from the boiler heats the feed before its introduction into the boiler. The result is evidently to equalize, in a great measure, the temperature of the water and steam contained in the boiler with no apparent, though with an undeniable economy. The phenomenon may be explained as follows:

When the water enters the heating tubes it travels without boiling through a certain length of those tubes; the lower its temperature is below that of the steam the longer this distance; and, since the circulation is caused by the development of bubbles in the tubes, the intensity of the circulation is reduced as this difference of temperature increases.

For the last two years I have obtained the same result in the most simple manner by introducing the feed in the steam space under the form of spray, as far as possible from that part where steam is taken for the engines. The feed being already heated by steam having done work in the H. P. and M. P. cylinders, there is scarcely any difference of temperature between the water and the steam in the boiler. As soon as the water enters the heating tubes bubbles of steam are produced, and the circulation is increased to such a rate that the temperature of the tube is not higher than with cold feed. This mode of introducing the feed, which has the further advantage of depositing the calcareous salts in the form of powder, when using sea water, requires some very simple but particular arrangement in order to avoid shocks in the feed pipes.

ON COMBUSTION.

The temperature of the products of combustion would be enormous and greatly superior to that at which dissociation of carbonic acid and steam takes place, if it could be completed in the fire box. Starting from this undeniable fact, some engineers think that heat should be progressively subtracted by cool surfaces during the combustion of coal. This is certainly not the case. No cooling should take place during combustion, and the necessary dissociation of carbonic acid and steam ought not to be avoided, provided sufficient air is admitted to secure further recombination. In fact, the boiler grate ought to give the same result, though by different means, as the gazogene used in metallurgy; but all the necessary air should be given at once, the greater part passing through the grate, since it increases the draft, whereas that which is admitted above reduces it. It matters little for the final result whether air be admitted at one time for producing carbon oxide, and afterwards for completing the combustion, provided no free carbon exists in the hot gases before they are cooled by the cluster of tubes. A very good proof of the soundness of these views may be found in the combustion of petroleum, which can not give its total heat unless it takes place in a white-hot refractory receiver, where it is impossible to avoid dissociation. The use of the brick arch in locomotive fire boxes has proved equally advantageous for the complete combustion of coal, especially coal rich in hydrocarbons. For the same reasons it is most important to have high and large fire boxes, where the hot gases are well mixed, and remain as long as possible before entering the cluster of tubes.

ON THE SECTION OF PASSAGE AND LENGTH OF TRAVEL OF HOT GASES.

With a given capacity of boiler, the section of passage may be very great and the length of travel very small, or the section may be very small and the travel very long, with all intermediate proportions between these extreme limits. In the first case the draft is good, but the heating surface is very seldom thoroughly utilized. In the second case a good air pressure is necessary, but the economic duty is better, because the hot gases are obliged to heat the whole of the heating surface, and because the transmission of heat increases with the agitation of gases, as it does in the case of water. This was proved a great many years ago by some most important trials made in France by Mr. Geffroy, of the Northern Railway of France, on a locomotive boiler. (For details, *see* Ser., Vol. I, p. 564.) The evaporation was measured, first with all tubes open, and second with half the tubes only. In the last case, notwithstanding the enormous reduction of heating surface, the evaporation per pound of coal remained the same, with this difference only, that a greater air pressure was necessary. The conclusion to be derived is that the section for the passage of the hot gases should be reduced and their travel lengthened as much as is consistent with the draft available.

The rules given above are certainly not the only ones necessary for making a good water-tube boiler, intended to resist intense firing, but they are certainly the most important.

In order to avoid all misunderstanding, I will show how they have been applied in Normand's boiler. My intention is not to make known an apparatus that has already been many times successfully tried in France and abroad, but I have chosen it because I believe it embodies more completely than any other the above principles. In general appearance (*see* figs. 2, 3, 4, and 5) the boiler is the same as that used since 1892,* but the arrangement of the cluster of tubes is new and has been applied on the three torpedo boats lately delivered (Nos. 183, 184, and 185). This arrangement gives a higher economic duty than the former one. Fig. 2 is a vertical longitudinal section. Fig. 3 is a transverse vertical section through part L of the cluster of tubes. Fig. 4 is the same through part M. Fig. 5 is a longitudinal section of one cluster of tubes through X Y.

The particulars of the boiler shown in the drawings are:

Grate surface	39 square feet.
Heating surface	1,840 square feet.
Number of tubes	1,284
External diameter of tubes	$1\frac{3}{16}$ inches.
Internal diameter of tubes	1 inch bare.
Pressure	200 pounds per square inch.
Weight, with all valves, bricks, fittings, etc, without water	10 tons 9 cwt.
Total weight, with water	13 tons 2 cwt.

In No. 185 (single screw) the power of the engine was measured and found to be, at the official full-speed trial, 1,680 I. H. P.

Air pressure	$3\frac{1}{2}$ inches.
Consumption of coal per hour	2,600 pounds.
Consumption of coal per hour per square foot of grate	67 pounds.
Consumption of coal per hour per indicated horsepower	1.56 pounds.
Indicated horsepower per square foot of fire grate	43.
Indicated horsepower per square foot of heating surface	0.91.
Mean temperature of feed	241 degrees F.
Mean temperature of gases in funnel	708 degrees F.

The fire bars were too close; more air will be admitted in future. At 14 knots the consumption of coal is under 1 pound per indicated horsepower per hour.

I will now show that the arrangements of this boiler are in accordance with the rules set down above.

As indicated by arrows, the hot gases enter, on both sides of the boiler, the cluster of tubes L at the front end only, and through the whole height. They afterwards travel horizontally to the other end, where the funnel is situated. An inverted bridge, F, pierced with small holes, H, forces the gases to heat the lower part of the tubes before entering the funnel; otherwise the upper part only would be heated. The general direction of the tubes, especially in the more heated part, is such that bubbles of steam will rise easily, and that none of the steam produced can return to the lower reservoirs.

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* *See* fig. 30, p. 261, No. XIII.

The height of the fire box is very great, and the greater part of the flames and hot gases remain a long time in it, being obliged to come to the front before entering the cluster of tubes. The motion thus imparted to the flames is favorable to complete combustion. The ratio of length to inside diameter in the longer tubes is 68, whereas in the former type A, of Du Temple boiler, it was 160 and 320 in type B. The curves of the tubes are sufficient to prevent any undue strains from expansion. The diameter of the three return tubes is such that the difference of pressure between the upper and lower reservoirs must be very small. In boilers now building at my works the return tube at the funnel end has been dispensed with. The section of passage of the hot gases is not so large that any part of the heating surface could be left out. Their length of travel is great, and the motion, being perpendicular to the axis of the tubes, is favorable to their agitation and consequently to the transmission of heat. On the other hand, it requires a higher air pressure. Should a better draft be found necessary the width of the clusters of tubes might be increased. The upper end of the tubes is under water, and the shape of the tubes is such that the formation of "steam chambers" is impossible.

Water circulation begins as soon as the fire is lighted. It becomes intense at full power. When the vessel is laid up the boiler may be completely filled with pure water saturated with lime. No air can remain in the tubes. This is of great importance as regards durability. It is indeed difficult to see why the firing could not be increased from what it was in the trial above mentioned if the tubes only are taken into account. From my own experience, it is the durability of the fire bars and bricks which limits the intensity of the fire.

Objections have been made about the necessity of removing several tubes should one middle tube be damaged. The quality of mild steel tubes is such that they may be taken out and replaced without the least difficulty. No better proof can be given of the feasibility of this plan than the following: The three boilers of Nos. 183, 184, and 185 were finished when it was decided to alter the arrangement of the clusters, according to the new design. With very simple tools hundreds of tubes were removed and replaced after having had their shape altered without any of them being damaged.

Most of the principles laid down in this paper may appear to be so simple as to render their statement useless. It is not so if we consider how very few of the different types of water-tube boilers are designed in accordance with all of them. However, my object is not to criticise any of these types, when not intended for intense firing, although the best boilers for intense firing are also generally the best for slow work. Many water-tube boilers are now making steam with tubes nearly horizontal, very low fire boxes, great section of passage, and short length of travel. Each can boast of particular advantages which can not be disputed. But the conditions imposed for boilers become more and more severe. In order to save weights the combustion of fuel per square foot of grate increases every day; 20 pounds is no longer sufficient, twice, perhaps three times, as much will be soon expected for the most powerful engines. A good design will give the owner, the engineer, or the navy that adopts it a great advantage. It is worth while to examine how it will be possible to meet impending exigencies.

[Abstract of discussion, from Engineering, London, June 21, 1895.]

The first speaker was Mr. Thornycroft, who said that he differed somewhat from M. Normand in his views, but the points of difference were perhaps more apparent than real. M. Normand had adapted the principle used in his feed heater to his boiler; that is, that he had taken the trouble to cause the gases to cross the heating surface of the tubes so as to agitate them and make them part with their heat. He had in this way tried an experiment which might have led to trouble; but as he had succeeded, they must give him the credit due to success. The Normand boiler was evolved from that of Du Temple, which was not inclosed by water tubes, but by a casing. One of the speaker's improvements was to inclose the boiler in a water envelope, by which radiation and heating of the casing was reduced. This was an important point, especially in cases where space was limited. In the front part of his boiler he made the heat go through a limited number of tubes, and this might distress them more. Referring to the question of circulation, Mr. Thornycroft said that, so far as he could see, the force of gravity was all they had to depend upon to make the water flow in the boiler. They might go to another planet where the trouble due to lack of circulation would be more easily overcome, while if they descended to the center of the earth no boiler at all could be made to answer. He had lately had set before him the problem of designing a boiler where simplicity was required. In that case he had used the tubes to form fire bars. Here there were horizontal tubes with water circulating through them, and they had been used for some time in a boat without suffering in any way.

It had been claimed that the system of natural circulation, which now distinguished the modern water-tube boiler, was due to Du Temple. He thought perhaps writers on this subject had been misled by something he himself stated when he prepared a paper in 1889. He did not at that time know what had been done in boilers used in driving road locomotives, but he found that a boiler made by Gurney in 1825 had tubes to return the water to the lower part of the boiler. That, of course, was before M. Du Temple introduced his boiler, though the latter doubtless was not aware what had been done previously. Mr. Thornycroft, in referring to the likeness between the boiler illustrated in the author's paper and his own invention, pointed out that M. Normand had been apparently driven to place some of his tubes above water. The speaker was still of opinion that it was better to have all the tubes above water. M. Normand apparently thought not. In considering this question many persons appeared to base their arguments upon the assumption that there was a steady flow of water circulating through the tubes. That was not the case; the water came intermittently. This was shown by the paper he had read at a previous meeting, when he had quoted experiments proving that the flow of water discharged from tubes above the water level in the receiving drum was twice as great as was the case when the tubes were below the water level.

Mr. Yarrow, who rose at the request of the president, said he had just been informed by Mr. Holmes that the time at the disposal of the meeting was very short. He would not, therefore, attempt to discuss the many important points raised by the two papers, and would content himself with expressing his appreciation of the great services rendered by M. Normand to the science of marine engineering in the work he had done and the papers he had contributed.

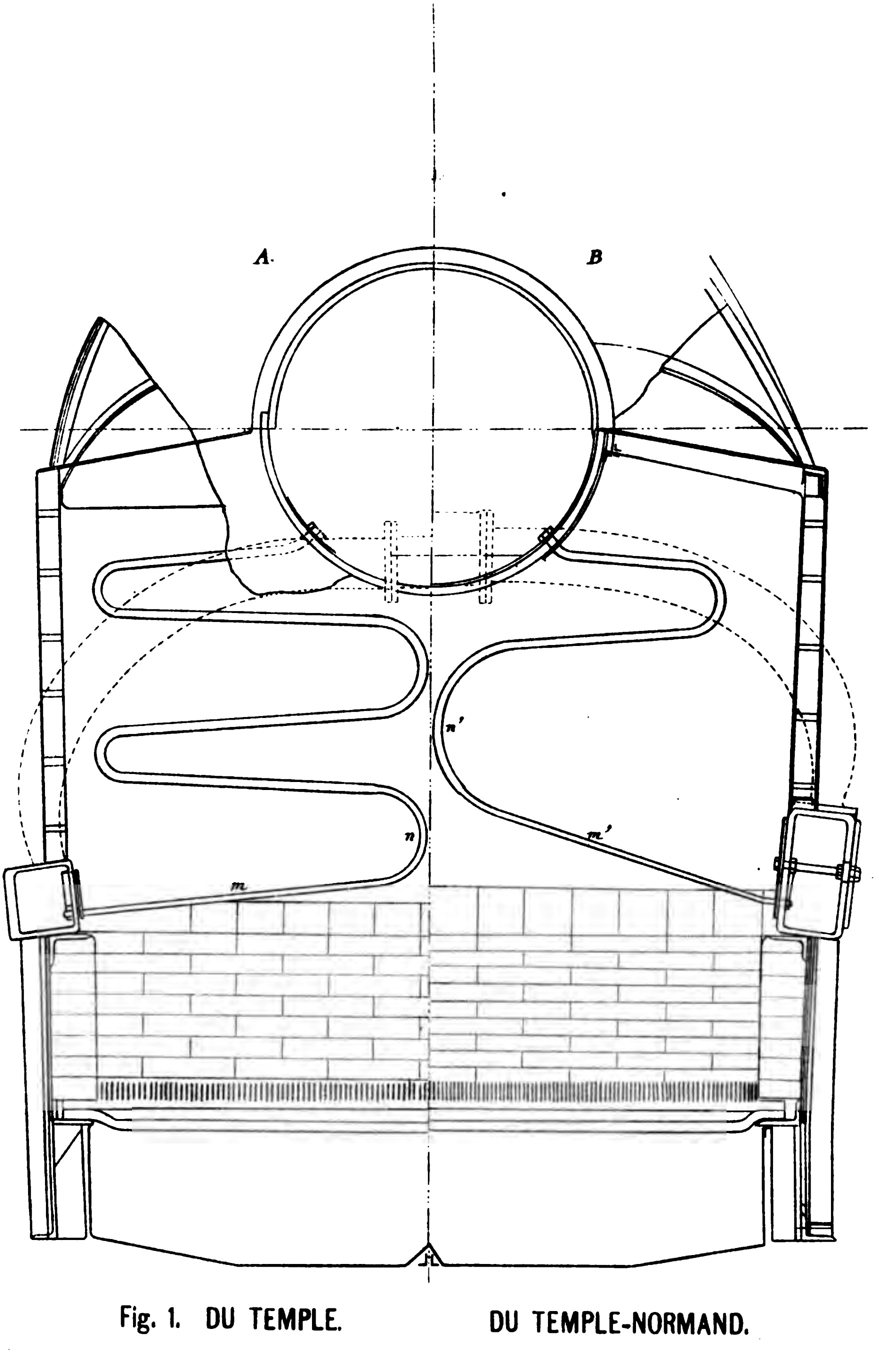
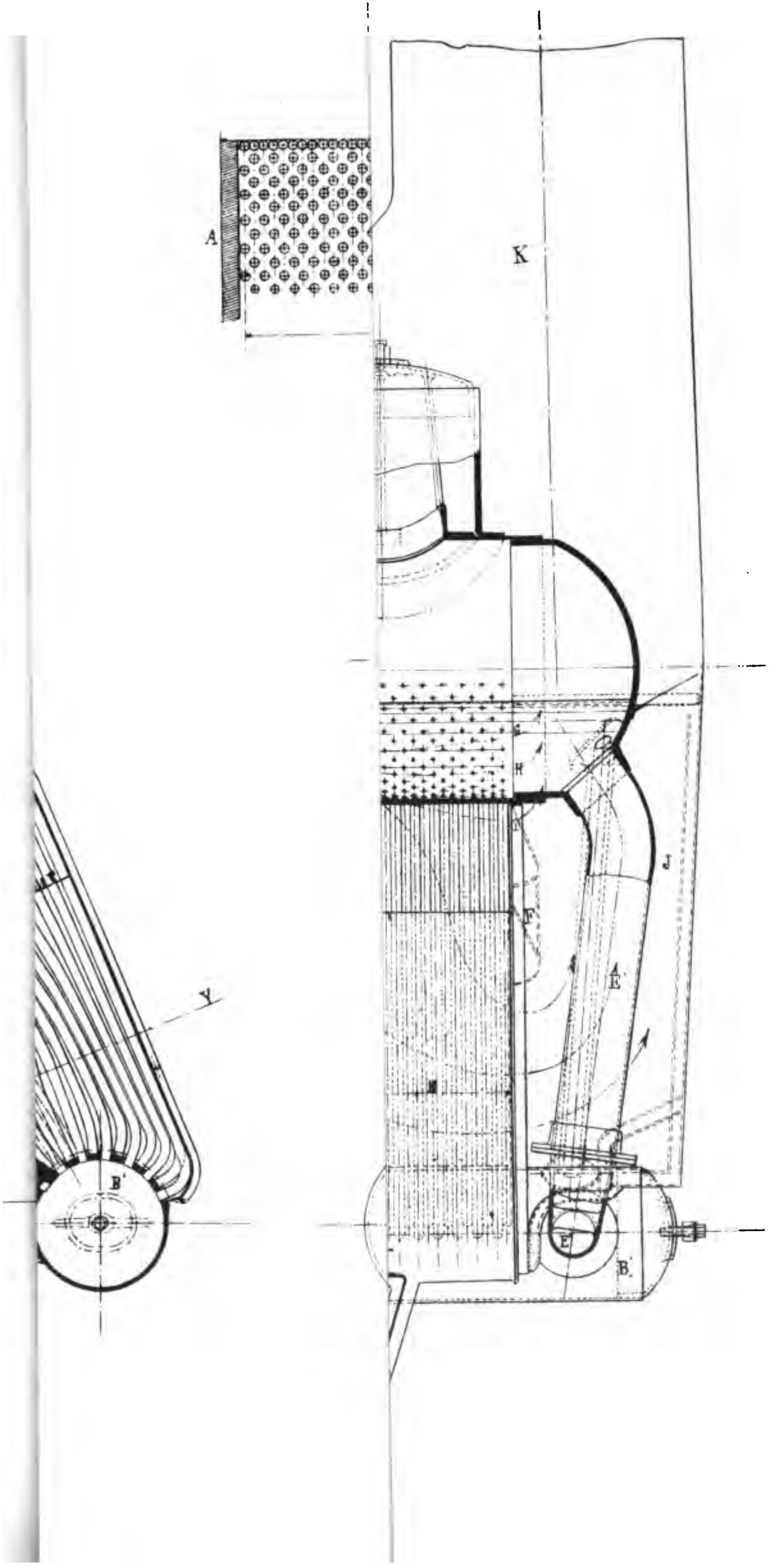


Fig. 1. DU TEMPLE. DU TEMPLE-NORMAND.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VI.

TUBULOUS BOILERS IN THE FRENCH NAVY.

By Assistant Engineer JOHN K. ROBISON, United States Navy.

[Reprinted, by permission, from the Journal of the American Society of Naval Engineers, Washington, D. C.]

In what follows I have endeavored to place before the readers of the Journal the result of my observation of the practical working of tubulous boilers in France, with such data regarding the most important of them as could be obtained.

In nearly every vessel under construction for the French navy the boilers are of the tubulous type, and cylindrical boilers have almost entirely disappeared from designs for men-of-war in favor of the lighter tubulous ones. For torpedo boats and other vessels of small size the boilers are generally of the Thornycroft or Normand type, and, except for slight differences in detail, are similar to those used in this country. The French seem to get better results from the Normand and Lagrafel than from the Thornycroft that were first used in their navy for torpedo boats, but this is largely due to the fact that the later boilers are of French design and manufacture.

The boilers which are designed to replace the large cylindrical ones that are used in all other countries for large vessels are those that present the most novelty to us, and are the ones which will be considered here. There are only three types which can be said to have any chance of replacing the Scotch boiler—the Belleville, the D'Allest, and the Niclausse. Other types essay to fill the places of these boilers, but so far as I know the three named are the only types that are used in vessels larger than gunboats. Others have been tried with a view to applying them in large vessels, but so far they have not been a success.

Of the boilers mentioned, the Belleville* is the oldest type. It is claimed for it that it is also the oldest tubulous boiler, and it probably is the oldest French one. It is too well known to require description, but some consideration of its working may not be out of place when it is considered that the results are those reached where the experience has been greater than ours.

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*See pp. 115 and 116, General Information Series, No. IV; 233 and Plate IV, No. VII; 237, No. XIII.

The extremely small quantity of water in the boiler has made the use of an automatic feed regulator necessary. This regulator works well when it does work, but fails to work at all often enough to destroy all confidence in it. Besides when the regulator fails to work serious accidents often result. The amount of feed water is so small that any failure of the regulator to act is liable to cause the water to disappear entirely from the boiler. The small quantity of water in the boiler likewise causes large variations in the steam pressure and necessitates a larger pressure in the boiler than at the engines; that is to say, there is a reducing valve between the boilers and the engines.

The slow circulation of the water causes the tubes to deteriorate very rapidly if the water is not pure. The tubes of the lowest row are made very thick, but they wear out very rapidly nevertheless, being bent after fires are lighted under the boilers two or three times.

The system of circulation of the water causes a great deal of priming, and this can not be cured even with the use of a complicated set of baffle plates in the steam drum of the boiler and with the addition of a separator between the boilers and the reducing valve. The reducing valve must also reduce the amount of water in the steam, though, as has been seen, this is not the prime object of its use. It has been estimated by engineers that have worked these boilers for several years that the amount of water in the steam at the cylinders is never less than 10 per cent.

The use of the Belleville boilers was said at the outset to be sure to give a great gain in economy of fuel. In fact many engineers still seem to think that they are not greatly inferior to the Scotch boilers in this respect. The fact is, however, that the arrangement for the combustion of the coal to take place entirely in one place has made the mixing of the gases of combustion very poor. To insure their proper mixing all the gas from the grate should be brought together at some point before the combustion is supposed to be completed. This would correct the inequalities in the thickness of the fires in different parts of the grate. So very poor is the mixing of the gases in the Belleville boiler that it has been found necessary to have a pump for forcing jets of compressed air in the top of the furnace, forcing the gases of combustion down toward the grate and so promoting their thorough mixing.

The absolute necessity of a sure-acting feed pump has led to the use of a specially designed pump that will always be sure to act. This result is obtained at the cost of a large amount of steam for the pumps, but the result is so necessary that it has been said that the pump is what makes the boilers.

The accessories to this boiler are so numerous that they make a considerable addition to the machinery of a vessel. The number of separate machines that are required to make this boiler act in at all a safe way leads to an exaggerated amount of repairs, and the care of the steam-producing plant becomes a more difficult matter than that of the engines. The repairs to the boilers are more costly than those for ordinary boilers. Not that any one case of repairs is not cheaper than a similar job would be with Scotch boilers, but the greater number of repairs has led to greater expenses for the Government in the repair shops. The repairs can, however, be made in a much shorter time than with the cylindrical boilers, and this must be held to counterbalance in a large degree the greater frequency of breakdowns in the boilers. Also the large number of boilers in the steam-producing plant of a powerful ship makes the loss due to the putting out of commission of any one boiler a minimum. It is also to be noted that all ships that are fitted with these boilers have more boilers than are necessary to the running of the engines at full power. Thus it is always possible to run at full power even with one or more boilers disabled.

The advantages of the Belleville boiler over the Scotch boiler that are the most appreciated in France are the great gain on the weight of the steam-producing plant, even with a reduction in the forcing of the boilers, and the ease of raising steam. The pressure allowed for this boiler is practically unlimited by the boiler on account of the small diameter of the cylinders that contain the steam. The parts are small and can easily be removed from the boiler rooms without cutting any holes in the decks. In fact, the whole boiler may be removed from the boiler room without troubling the decks at all.

The manufacturers of this boiler claim that it is possible to use salt water in it without any bad effects. Though it has never been intended that they more than any other working at a high pressure should be usually fed with salt water, it has been occasionally necessary to use salt water in them. The results have not been of the best. The tubes were found to be eaten away, and the rods of the feed regulator were soon covered with incrustations that prevented it from acting, and so entirely destroyed the boiler.

As has been said, these were the first French tubulous boilers. While Mr. Belleville has been constantly at work devising methods for making his boiler run with success, other people have been busy devising some way of getting around the difficulties in the Belleville boilers by a change in the system.

The D'Allest boiler, or more properly the Lagrafel-D'Allest, is probably the best of the attempts to secure a substitute for the Scotch boilers. This boiler has been described in the Journal,* but some recent changes that have been made may be an excuse for going over the ground again. This description will follow, but the following is the result of observations made on the comparative working of these boilers and the Belleville. Each boiler, it will be remarked, has advantages over the other.

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* *See* p. 258, No. XIII.

The D'Allest boilers (figs. 1 and 2) are not quite so heavy as the Belleville, but the floor space occupied is greater for the same area of grate or heating surface. As, however, the D'Allest boilers are much more capable of being forced than the Belleville (which are uneconomical with over 15 pounds of coal burned per square foot of grate), it may be said that the space occupied by the D'Allest boilers is not greater for the same power than that required by the Belleville. A great advantage for the D'Allest boilers is that with them it is unnecessary to have more than the ordinary auxiliaries of the Scotch boilers, and the frequency of repairs with the Belleville boilers is thus avoided. The amount of water in the D'Allest boilers is not, of course, so great as in Scotch boilers, but it is sufficient to make the use of that bugbear of the practical engineer, the automatic feed regulator, unnecessary. The cost of running the D'Allest boiler is far less than that of the Belleville, and, indeed, it may be said that on this point the D'Allest boiler may be compared with the Scotch. It has an independent combustion chamber, and thus the gases are well mixed before entering the uptake. The results of steaming with this boiler are in marked contrast with those from the use of the Belleville. While the D'Allest boilers have not required more coal than Scotch boilers for similar engines, the loss in coal has been with the Belleville boilers as much as 42 per cent, as will be seen later.

The greatest advantage of the Belleville boilers over the D'Allest lies in the comparative freedom of the tubes of the Belleville boiler to expand when heated, they being fastened at only two points in each element while those of the D'Allest are fastened, the same as the tubes of Scotch boilers, at both ends of each tube. This reduces the danger of leaky tubes in the Belleville below what it is in the D'Allest boilers. Another advantage of the Belleville over the D'Allest lies in the fact that the parts of the former are smaller than those of the latter, and that therefore there is less difficulty in removing them from the fire rooms in case of injury beyond repair. When one considers the fact that the French Government requires reducing valves to be placed between the boilers and the engines whenever tubulous boilers of any type whatever are used, some excuse for the use of the Belleville in preference to the D'Allest boiler may be found. Of course, the question of the advisability of using any type of tubulous boilers is quite apart from the question of the superiority of one tubulous boiler over another.

Of the many other types that have been proposed for replacing the Scotch boilers there is but one, the Niclausse,* that has so far been recognized as possessing the points that are requisite for use in men-of-war. These boilers are modifications of the Collet, that have been fully described in the Journal. The differences between the new boiler and the older one lie almost entirely in the details of construction, the main points of the boilers being the same. These boilers are as different from the others as the latter are from each other. They are compared only with the D'Allest, as the latter are so evidently superior to the Belleville that it would be waste of time to include a second comparison.

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* *See* p. 261, No. XIII.

The weights of the D'Allest and the Niclausse boilers are practically the same for the same area of heating surface, with the same advantage for the Niclausse in regard to the space occupied as for the Belleville boiler. But while the Niclausse boilers are capable of being forced more nearly to the power of the D'Allest than the Belleville boilers are, they are not the equals of the D'Allest in their capacity for high powers. It may, therefore, again be said that the D'Allest boiler takes up less space for the same power than the Niclausse. Both of these boilers give dry steam at the highest powers at which they are run, and therefore have a point of advantage over the Belleville. The amount of water in the Niclausse is less than in the D'Allest, but it is still large enough so that the water level may be easily maintained without the use of any other than the ordinary check valves on the boilers. The greater the amount of water in any boiler, however, the better it is for keeping a steady steam pressure; and some difficulty was experienced in maintaining the pressure of steam constant during the forced-draft trials of the *Friant* (fitted with Niclausse boilers). The frequency of repairs to one of these boilers is about the same as for the other, and the cost is about the same in each case. The joints in the Niclausse boiler are all metallic and conical, and so require more care in the making, but are less liable to give trouble when once made. The tubes are all free at one end, and therefore the danger of leaky tubes is reduced to a minimum. In fact, during all the trials of the *Friant*, there were no leaks in this boiler. It is another point in its favor that the repairs are all made from the front of the boiler. It must also be remarked that it is easier to mount and dismount a tube in the Niclausse than in any other type of tubulous or other boiler. The complete operation of removing a tube and replacing it with another took, in one instance within my observation, less than two minutes.

The advantages that the D'Allest boilers have are chiefly in the matter of economy. As has been said, they are about as good as the Scotch boilers, while the Niclausse or the Belleville give much poorer results in actual use than have been found from the use of ordinary boilers. Another advantage of the D'Allest boiler lies in the fact that the tubes in the rows next to the fires are all Serve tubes, and thus much less liable to burn out than ordinary tubes. It would be hard to use this type of tubes in the Niclausse boilers, on account of the inner circulating tube in each element. It would seem that tubes of the style used in the Niclausse boiler are the best, however, on account of their freedom to expand when the boiler is being fired. The one great advantage of the D'Allest boilers seems to lie in their great relative economy over any other tubulous boilers. Mr. D'Allest himself says that this advantage is almost if not entirely due to the use of an independent combustion chamber. There would be little difficulty in adding a combustion chamber to the Niclausse boiler, and then it would seem that this boiler would be inferior to the D'Allest in but the detail of the amount of water in the boiler. This defect could be remedied by a change in the size of the tubes to allow for the increased rate of evaporation rendered possible by the addition of the combustion chamber, and by the use of a larger steam drum at the top of the boiler. Perhaps even now it may be said to be a question whether the Niclausse boilers are not the equals of the D'Allest, but the opinion of French engineers seems to be that the D'Allest are the boilers of the future, and that, with a few changes, they can be readily supplied in the place of Scotch boilers. The addition of hydrokineters would reduce the disadvantages of the D'Allest tubes being fixed at both ends. This apparatus has not yet been used in these boilers.

In the use of these boilers in the French navy it is to be remarked that even with the number of spare boilers (20 per cent in many cases) and with the small rate of combustion allowed in all cases (never above 31 pounds of coal per square foot of grate), and with engines that are considerably heavier than those used for the same power in this country, the total weight of the machinery is not so great as in our latest ships. In no case of a modern French man-of-war fitted with tubulous boilers that I now recollect has the weight been over 200 pounds per I. H. P. of all the machinery; in most cases the weight is down to about 185 pounds. These figures are, of course, for large vessels of the battleship or fast-cruiser type. This seems to be the greatest if not the only advantage for the tubulous boilers. The pseudo advantage of quickness in raising steam is one that is more than counterbalanced by the always attendant greater difficulty in managing the boilers when under pressure.

The pertinent points that seem to me to need attention in the French boilers are that the tubes are always so arranged so as to be easily removed or cleaned. This seems to be an absolute requisite for any boiler that can entirely replace the Scotch boilers.

Tubulous boilers will always give more trouble to keep in good condition than would Scotch boilers, but they are sure to retain their full efficiency almost indefinitely, as the worn parts are replaced by new ones that are as strong as the old ones were in the first place. There is no shell to deteriorate.

It is also to be remarked that the tubes used in these boilers are invariably of a larger diameter than is generally used in the boilers made in this country. The gain in the weight of the boilers may be said to be about equal to the weight of the water in Scotch boilers that would have to be substituted for the tubulous boilers.

THE BELLEVILLE BOILERS OF THE AUSTRALIEN.

The Messageries Maritimes is one of the greatest steamship companies of France, if not the very greatest. This company began the use of Belleville boilers some five or six years ago. The officials of the company seem to be fairly well satisfied with the performance of them, but there is a tendency to obtain something that will give better economical results. Designs were prepared in the last vessel designed (the *Ernest Simon*) for the use of Scotch boilers. There was still a question as to which type of boilers would be adopted when I left France.

Of the vessels that are fitted with Belleville boilers in the fleet of this company the *Australien* is the oldest. She is a vessel about 466 feet in length, and of about 10,000 tons displacement. The mean speed on the trial trip was 17.5 knots. She has a single-screw vertical engine of 7,535 I. H. P. on the trials, and developing about 4,100 I. H. P. on the whole trip to Australia, giving a mean speed of about 15 knots. The engine was constructed in 1890 at the company's shops at La Ciotat, and is a triple-expansion engine with three cylinders. The evaporating plant is composed of twenty Belleville boilers for the main engines, and of one small cylindrical boiler for the distillers and for the winches on deck. These boilers (Belleville) have five, or for the most part six, elements each, and are twelve rows high. The total grate surface is 581.27 square feet.

The weight of the machinery is as follows:

Engines	tons..	750
Boilers and accessories	do...	392
Water in boilers	do...	20
Total for machinery	do...	1,162
Per I. H. P. (on 7,535 I. H. P.)	pounds..	340
Engines, per I. H. P	do...	220
Boilers, per I. H. P	do...	115
Boilers, with water, per I. H. P	do...	120

The fire room is fore and aft.

The watch for four hours consists of 1 engineer, 2 chief firemen, 3 first-class firemen, 2 Arab leading men of the fire room, 8 Arab firemen, 6 Arab coal passers, 2 European oilers, 2 Arab oilers; total, 26 men.

There have been some more or less important changes made in the fire room from the original designs. The pipe connecting the feed regulator to the boiler went originally directly to the ejector. It was found that this pipe soon filled with sediment, and caused the feed water to fail in the boiler. The pipe was changed to go directly to the feed-water collector at the base of the boiler. A tube was burned out in finding that this change was necessary.

The lever of each feed regulator has been fitted with a wire handle, so that it may be seen at any time whether the regulator is in working order or not. This is done by opening the regulator wide and seeing if the valve closes when the handle is loosed.

RUNNING OF THE BOILERS OF THE AUSTRALIEN.

Filling with water.—The boilers are always filled with fresh water, and never has any other water been used for this purpose. In the instructions sent to the company by Mr. Belleville provision is made for the use of salt water for filling the boilers, but the accidental use of salt water in making up feed gave such bad results that the company has never used it for originally filling the boilers.

Raising steam.—The grates are carefully cleaned and put in place. They are entirely covered with coal to a thickness of about 4 or 5 inches. At the front of the boiler a wall is built up around the furnace door. This wall of coal and kindling wood is lighted first. Before lighting the fires the safety valves are opened, the ash-pit doors are closed, and the furnace doors are left slightly open at first; the doors to the tube nest are closed.

When the little wall around the furnace door is well lighted, it is spread over the grate and the furnace doors closed; the ash-pit doors are then opened more or less according to the time allowed to raise steam. This time is generally about one and a half to two hours. Steam can be raised in less time, and it has been done in three-quarters of an hour, but the effects on the boiler are not good, and the rules of the company call for two hours in raising steam.

When the elbow communicating between the ejector and the collector on the boiler begins to warm up, the blow-off cocks are opened several times, and the boiler freed of the sediment in the base of the tubes. This serves to promote circulation in the boiler during the time that there is no steam drawn off to make the circulation sure. If this is not done, the water hammering in the tubes during the time that steam is being raised will cause trouble and may break any or all joints in the tubing of the boiler.

The feed pumps are kept going from the time the fires are lighted. As soon as the pressure of steam in the main boilers becomes great enough to run these pumps the steam is taken from the main boilers. (Pressure as much as 60 pounds.)

Getting under way.—If there is any delay in getting under way after steam is raised, the ash-pit doors are closed and the furnace doors opened. The feed pumps are kept working as always while the fires are lighted, and the extra steam is condensed. If the fires are properly managed there is no danger of steam blowing off from the safety valves, and it is rarely necessary to send any steam to the condenser. The stop valves are not open wide, nor is the pressure in the boilers allowed to exceed 150 pounds, until the engines are well under way. When the engines are first started there is great danger of "priming." The water level must be carefully watched and the feed regulators kept closed at this time. The fires are not forced until after the engines are started, nor are the doors opened. The doors of the tube nest are never opened except to clean tubes.

Working of the fires.—The firing must be thoroughly regular and methodical. There has been great difficulty in finding European firemen to do the work on these boilers. It is always necessary that the fires should be what would, in Scotch boilers, be considered low, that is to say, they are never more than 5 or 6 inches thick. At the same time it is absolutely necessary that there should be no holes in the grate, or the air would rush through at this point alone and leave the gases of combustion incompletely burned. The firemen that have been accustomed to the grates of the Scotch boilers seemingly can not learn to properly fire the furnaces of the Belleville boilers, which are so much wider than those of the Scotch boilers.

The grates are fired in rotation, beginning forward and working aft, and putting two or three shovelfuls of coal on the fires at a time. The tendency of the firemen is to fire only on the front of the grates, and care must be taken to prevent this. One grate is always in process of being fired. When those in one fire room have been fired, those of the other fire room are commenced, and so on until all the fires have been fed, when the operation is recommenced.

The safety valves are set at 220 pounds, and the steam at the cylinder is only at 185 pounds pressure. Variations in pressure between those limits have then no effect on the engines; but the limited quantity of water in the boilers makes rapid change of pressure frequent. A man is always at the gauge watching the pressure. The moment the pointer commences to drop the fires are pushed, and again the moment the pressure commences to rise the ash-pit doors must be closed. Failure to observe these precautions may cause the pressure to drop in one or two minutes from 200 pounds to 150 pounds, or it may increase to 250 pounds in as little time. The instant the pressure commences to rise is the one taken for cleaning fires.

Each grate is half cleaned every four hours, making the total time between cleaning fires eight hours, and preventing any part of any grate from ever getting very dirty. Two grates are often cleaned at a time, and the twenty grates are cleaned during each watch (half).

The cleaning of these grates is done in a slightly different way from that used with the grates of Scotch boilers. The part that is to be cleaned is cleared of coal, the burning coal being pushed on the other half of the grate. The clean part of the grate is then covered with fresh coal, and the clinkers, etc., on the dirty part of the grate are removed as soon as possible. The coal on the clean part of the grate is then spread over the whole grate, and the doors fixed as before cleaning fires. While cleaning fires, the valve on the feed pipe to this boiler is partly closed to prevent the boiler from filling with water. The mixer of the gases of combustion is left in operation during the cleaning. If care is taken in choosing the moment for cleaning fires the steam pressure will not fall during the operation.

The mixer of gases admits the air to the furnaces at a pressure about 5 pounds above that of the atmosphere. The air enters the furnaces through little nozzles at the top of the front of the boilers and is so directed as to force the gases of combustion downward toward the grate. This is calculated to mix the gases and so to insure the thorough burning of the coal. It is to be noted that the boilers were worked during an entire trip without using the gas mixer, and without any appreciable difference in the amount of coal used.

Feed.—All make up of waste feed is with fresh water. A distilling plant is placed on the ship for this purpose. The steam is formed in the donkey boiler and is sent to the second receiver on the main engines. A connection is fitted from the donkey boiler to the exhaust pipe which permits the direct condensation of the steam in distillers such as are used in our Navy. Lime is added to the feed water in a continuous fashion by means of a lime tank fitted above the air pumps and having an exhaust at the bottom of the condenser. This lime tank is fed by a small pipe from the feed pump discharge. Lime is added at the commencement of a voyage in the proportion of one pound for each pound of oil used in the cylinders. At the end of the voyage the ratio between the amount of lime and oil is increased to three.

The feed pumps are so arranged that any one of them can feed any boiler from either of the feed tanks. On the pipe to each boiler there is fitted at the main feed pipe a valve, and there is another graduated valve at the entrance of the feed water to the feed regulator. This graduated valve is much used in running the boiler, for the feed regulator is not entirely depended upon. The graduated valve is kept as far closed as possible, and allows the feed to enter the boiler in an amount slightly exceeding that required for the boiler. The regulator, which is almost always nearly wide open, is thus unable to let much more water in the boiler than is absolutely necessary. During rough weather the graduated valve is more finely fixed still, so that the feed regulator can not let too much water into the boiler, and so that it is necessary at intervals to open the graduated valve to give the boiler enough water. In some this graduated valve takes the place of the regular check valve on Scotch boilers, and the feed regulator is only depended on to do the regulating of the feed more finely than would be possible by hand. In this way only can any dependence be placed on the feed regulator. The check valve of the boiler is included in the graduated valve and not in the feed regulator.

On leaving the graduated valve the water enters the feed regulator, and from there enters the cylindrical reservoir at the top of the boiler. After passing the entire length of the reservoir, the water enters the ejector. It would seem that the water is heated sufficiently by its passage through the reservoir to deposit the greater part of the solid matter it contained on entering the boiler. The ejector keeps the greater part of this matter, and it may be removed from the boiler by use of the blow-off valve on the ejector. This blowing down is sometimes done in a continual fashion by opening a cock on the ejector and leaving it partly open during all the time the boiler is in use. The steam on leaving the ejector passes to the feed-water collector on the bottom of the elements, and from there to the tubes. The water level in the boiler is about at the middle of the height of the tubes.

The ejector is used every twelve hours on each boiler. The valve is simply opened wide and then closed. This is repeated two or three times, and, as already said, may be used in a continuous way. This latter method is not used except in the case of leaky condenser tubes and the consequent presence of salt water in the boiler. Toward the end of a trip the blow-off cock is used every four hours.

With salt water in the boiler for any cause, the fires are forced and the circulation is thus kept rapid. Lime is added to the feed water in sufficient quantities to neutralize it completely, and frequent use is made of the blow-off cocks. The saturation of the water should not be allowed to exceed 2.

The amount of lime added to the feed is about 11 pounds per ton of feed water. The throttle valve should be closed as much as possible, and thus the "priming" is reduced. There is more danger of "priming" with salt water than with fresh water, and as even with fresh water there is never less than 10 per cent of water in the steam at the cylinders, there is great danger in the use of salt water of getting so much water that the working of the engines would be interfered with. There is always danger of tubes giving way with the use of salt water, and the boiler is then of no use until the tube is replaced. This is of little danger in any other way, as the breaking of a tube is dangerous to those in the fire room only if the furnace door is opened by the first shock. After that there is no danger of the steam entering the fire room. The average life of the tubes is from two to three years. The causes of burning are the failing of the feed or the internal corrosion in the tubes, which is the result of use in whatever conditions.

The feed regulator is liable to fail in use. The wire test placed on each regulator is used as often as possible, say every hour. Nevertheless, the regulators are apt to give trouble by "going to sleep." This may be caused by the formation of deposits on the regulator rods or on the valve itself. Even dust on the outside of the regulator, on the moving parts, is liable to cause it to fail to act. As one of the engineers on the *Australien* said: "A regulator may not fail for four hours, but then again three or four of them may fail in that time." All the water levels are protected, and fully as much attention is paid to them as with the ordinary boilers, but frequently the regulator will fail, and the drop in the water of the boiler will not be noticed till too late. The great trouble with the regulator is that when the water is lowest the effort on the regulator is the greatest, and several times they have opened after the water had entirely disappeared from the boiler, and even when the boiler was red hot. In that case it is clear something had to break. It was always a tube or tubes. In one case tubes of every element in a boiler burned out at the same time, and due to the above cause. This failure of the feed, due to a failure of the automatic feed, is the cause of most of the accidents to the boiler. The engineers of the Messageries Maritimes have tried to do without the regulators, but have not succeeded in regulating the water well enough in this way to run them without a man on each boiler with that for his duty and nothing else. As soon as the regulator is found to have failed, which will generally be discovered when a tube bursts, the fires are drawn from the boiler. It requires about ten minutes to empty a boiler and to burn out a tube after the regulator fails.

Steam.—The baffle plates in the reservoir at the top of the boilers do not prevent the carrying away from the boiler of about 50 per cent of water in the steam. The separator reduces this amount about fivefold, and the reducing valve makes a further though unimportant reduction in the amount of water in the steam. There is not, in general, enough water in the steam to interfere with the working of the engines, though this sometimes occurs. The trap on the separator does not work well. It is designed to be automatic, but is always worked by hand.

The reducing valve works well and maintains a constant pressure at the engines while the pressure at the boilers is above 185 pounds. When the engines are working slowly, or when they are stopped, the pressure at the engines has a tendency to be the same as that at the boilers, but as the pressure at the boilers is then generally below the working pressure of the engines, there is no harm in this inconvenience common to all reducing valves.

Feed pumps.—It is said that these pumps are the soul of the boilers. When there is too much water in the boilers the pumps stop, and on the contrary if the water in the boilers gets low the pumps go very fast. This seems to me to be the result of the more or less complete action of the feed regulators. The pumps are, however, of the design that is necessary for these boilers, with large steam cylinders and consequent sure action of the pumps. The action of the boilers depends entirely on the action of the feed pumps, and these pumps must be sure in their action. The ordinary feed pumps that were used in part on these boats have not given satisfaction, and the Belleville pumps are the only French feed pumps that can be used.

Sweeping the tubes by steam.—At first the boilers of this ship were cleaned as is usual with all boilers, by steam. No great difficulty was experienced with the arrangements for sweeping the tubes, and the satisfaction was perfect in all but one respect. The quantity of steam required was so great that it was not possible to make enough fresh water to make up the waste feed. After the trial of salt water for this purpose the bad results on the boiler tubes were so apparent that it was seen that only fresh water could be used. For that reason the sweeping of the tubes with steam has been entirely discontinued.

Now the practice is to have three or four of the twenty boilers out of use at all times, so that all may be cleaned in rotation, and each one after about three days' use. As soon as the boiler is cold it is cleaned, fires lighted, and another boiler put through the same treatment. The tubes of the lowest row are often covered with siliceous barnacles, which are carefully removed every time the boiler is cleaned.

Banking fires.—This is done in the ordinary way. The pressure in the boilers is reduced to about 75 pounds, the blow-off cocks frequently used, and the feed pumps kept running slowly. The blow cocks are used as when under way. Banking fires in these boilers is bad for the tubes. The water has no circulation to speak of, and that in the lower tubes soon becomes highly concentrated. The slow evaporation sends the steam to the reservoir at the top of the boiler, and the steam being there condensed the lightest water remains at the top of the boiler, and the heavy water, containing all the sediment, at the bottom and in the lowest tubes.

Cleaning the boilers completely.—The outside of the boiler is cleaned by brushes in the regular way. The inside is cleaned after being washed with caustic soda. For this washing about 35 pounds of caustic soda is put in each boiler. The boiler is then completely filled by adding fresh water. The fires are then lighted and a pressure of about 15 pounds is kept up for two or three hours. Then the feed-water collector at the bottom of the elements is opened and the height of the water reduced to the normal working level. The fires are then worked and the engine turned at the dock. This is kept up for three or four hours. The working of the engines cleans not only the boiler, but also the piping and the cylinders, the amount of water carried over to the engines by the steam being sufficient for this. The boilers are then completely blown down and the water put overboard. It will be found that the water contains a great deal of oil, and even that there are solid particles in the water thus thrown away. This cleaning is done every three months.

After the boiler has been washed the joints of all tubes are broken and the mud that remains in them is removed while it is still soft. The quantity of this mud is not great. During this cleaning of the inside of the boiler care is taken to look out for corrosion, or the beginning of the burning of a tube. The washing of the boilers is done while they are still warm from working, but after the fires have been drawn, of course.

As summed up by one of the ship's engineers:

> The great advantage of these boilers is the ease with which they can be repaired. A tube can be replaced in two hours, and this is the most frequent accident to the boilers. The tubes are the weakest part. The Belleville feed pump is what makes the boiler.

> It is perfect. The ejector is good for what it is intended. With fresh feed water, even without a filter (which would be a great improvement), and by adding lime to the feed all the time, there is no danger from any deposits in the tubes. There will always be some deposits in the tubes, but nothing to speak of. The reducing valve is very good and always works well. It is rare that there is sufficient priming to interfere with the working of the engines, although it is always considerable.
>
> It is not possible to keep up the water level by hand, except by using a man for each boiler for this purpose. The great trouble comes from the use of even a small quantity of salt water in the boilers. The regulator is soon clogged up and does not work, and then firing must be stopped. Yet some feed regulator is indispensable. The firing is difficult. An ordinary fireman can never succeed here.
>
> The Belleville boilers are much less economical than the ordinary ones, and the cost of making repairs to them is greater than for Scotch boilers. Besides this, their first cost is greater. Great care has to be exercised with all these delicate machines, and you can never tell what will be the next thing to break down. If you want Belleville boilers you must have engineers everywhere. It seems to me that there is no doubt that the ordinary (Scotch) boilers are the boilers to have, and that there is no use of bothering one's self with all this machinery. If the regulator sticks the boiler must be put out of use. The automatic separator trap is not satisfactory and is always worked by hand.

An attachment has been fitted permitting the fires to be drowned with water while on the grates.

The Belleville boilers show a saving in weight over Scotch boilers about equal to the weight of the water in the latter, and a saving in space of about 7 per cent. This saving in space varies according to the ship from zero to 10 per cent. The ratio between the heating and the grate surfaces is about 30.

The cost of running the engines of the *Australien* during the year 1893 was 2.30 pounds per I. H. P. The estimates for this ship called for a speed of 19 knots on the trials (17.52 realized), and for 17 knots in ordinary running (14.60 realized). The cost of the power was set at 1.54 pounds per I. H. P. It is evident that these boilers have not been remarkable in their economy.

On the ships of this line which use Scotch boilers, and those of an old type with pressures of 90 and 100 pounds, with old compound engines, the cost of a horsepower during the year 1893 was 2.02 pounds per hour. If the use of triple-expansion engines gives an economy of 20 per cent, the cost of the Belleville boilers in coal alone exceeds that of Scotch boilers by 42 per cent. If the *Australien* had been fitted with Scotch boilers she could have made a trip to Australia with a less weight of coal and machinery than with the present boilers. The question of cost, it will be remembered, has not been touched upon.

BELLEVILLE BOILERS IN THE FRENCH NAVY.

Nearly one-half of the vessels now being constructed for the French navy are to be fitted with Belleville boilers. Those now in use have given fair satisfaction.

On the ships now fitted with these boilers a filter is always used between the air pump and the feed pumps. Lime is always added to the feed water in much the same way as on the *Australien*. The automatic feed regulators have given poor results in the navy, and the satisfaction is less than with the Messageries Maritimes. In some cases the feed regulators have been taken off the boilers and the feed regulated entirely by hand. Great difficulty is experienced in properly regulating the check valves, but this is thought to be better than relying on the regulators.

The lack of economy of these boilers has been condemned in the navy as in the merchant marine. On the trials of the *Brennus*, a battleship fitted with Belleville boilers, and the largest ship, in point of power at least, to be fitted with them, the results of the preliminary trials were most unsatisfactory. The coal per I. H. P. was 3.95 pounds on one trial, and later, when the firemen had become more accustomed to the boilers, this figure was reduced to about 2.45 pounds. This is at the most economical rate of speed for the ship. In calculating the consumption of the engines there is an auxiliary boiler that supplies all the auxiliary machinery except the air and circulating pumps, and the power of the main engines is used for the calculations. The power of the feed pumps is neglected and acts as a loss for the boiler furnishers. Neither of these trials was long enough to necessitate the fires being cleaned.

On the official trials I suppose these figures for the cost per I. H. P. were much improved. It may be interesting to compare these trials with those of the boilers of the *Jemmapes* fitted with D'Allest boilers, and with those of the *Friant* fitted with Niclausse boilers. The *Jemmapes* burned at the reduced rate of speed for which the Belleville boilers in the *Brennus* were tried, 1.84 pounds, while the *Friant* burned 1.94 pounds at the same reduced power. These trials took place at the same time and at the same place (Brest). The engines did not come from the same place, and were not of the same type. Those of the *Brennus* were probably the best, though those of the *Friant* were about as good. The engines of the *Jemmapes* were as good as those of either of the other ships, except that they were horizontal instead of vertical, as the others were.

The D'Allest boilers of the Carnot.

DIMENSIONS.

Pressure of steam at boilers	pounds	213.6
Grate surface (of 8 of the 24 boilers on the ship)	square feet	361.73
Heating surface of the tubes	do	10,316
Heating surface of the water legs	do	404.8
Total heating surface of 8 boilers	do	10,720.8
Number of tubes		1,592
Interior diameter of tubes	inches	2.874
Exterior diameter of tubes	do	3.15
Length of tubes between sheets	feet	7.88
Section of opening of front ash-pit doors	square feet	9.47
Section above the middle brick wall	do	9.04

Section of opening between tubes at entry of gases	square feet..	7.75
Section of opening between tubes at discharge of gases	do....	7
Section of smoke pipe for 8 boilers	do....	61.9
Volume of steam in boilers and steam collectors	cubic feet..	1,059.5
Weight of water in boilers	tons..	24.8

WEIGHT OF ONE BOILER.

Front water leg, outside sheet	pounds..	735
Front water leg, tube sheet	do....	880
Back water leg, outside sheet	do....	1,129
Back water leg, tube sheet	do....	1,124
Forward end of steam drum	do....	440
After end of steam drum	do....	440
Angle iron on forward water leg	do....	264
Angle iron on after water leg	do....	374
Shell of steam drum	do....	3,080
Side of forward water leg	do....	627
Side of after water leg	do....	561
Rivets (for the heads only)	do....	330
One manhole plate complete	do....	304
129 tubes at 30.8 pounds each	do....	6,129
398 tube plugs complete, at 2.2 pounds each	do....	876
16 screw stays for the steam drum	do....	1,197
Screw stays for the water legs	do....	1,155
Angle irons for attaching the smoke pipe	do....	334
Reenforcements for the safety valves	do....	77
Total weight of the boiler without water or fittings	do....	20,056

MOUNTING OF THE D'ALLEST BOILERS OF THE CARNOT.

The first D'Allest boilers to be manufactured at the Government shops at Indret were those of the *Carnot*. The design came from the inventor, who sent with the drawings a set of instructions for the mounting of the boilers. Those instructions are as follows:

Tube plates.—After the forging, chamfering, and drawing out of the edges of these plates is finished, the holes for the tubes and those for the water-leg stays are drilled in the tube sheet. The holes for the tubes are 3.15 inches for the rear tube sheet, and 3.23 inches for the forward tube sheet. The holes for the screw stays must be carefully centered between the holes for the tubes. After this operation the tube sheet is assembled with the angle iron attached to it in the design.

Plug sheets.—These plates are assembled with the ends of the steam drum as soon as they have been forged, chamfered, and drawn. The holes for neither the tubes nor the stays are made at this time.

Assembling the water leg.—Each tube sheet is then assembled with the corresponding plug sheet. Then the side of the water leg so formed is fitted to the plates. When the joints are faired, the rivet seams *a*, *b*, *c*, *d*, and *e* are made.

Assembling the water legs together.—Each tube sheet having been united with the corresponding plug sheet, and a water leg having been thus formed, the two water legs of a boiler are then placed at the

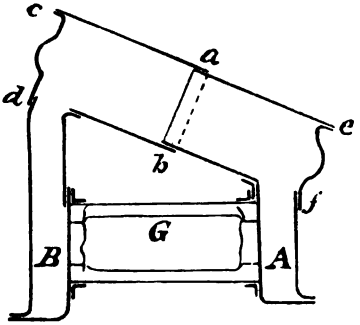

Fig. 3.—WATER LEGS OF D'ALLEST BOILER.

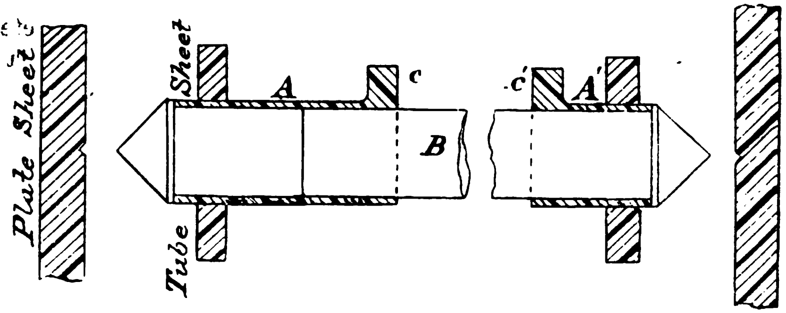

Fig. 4.—METHOD OF PROJECTING THE HOLES FROM TUBE SHEET, D'ALLEST BOILER.

designed distance, and the sheets of the steam drum mounted after being faired. When the joints between the drum and the water legs are fair the holes for the rivets of the seams *ab*, *cd*, *ef* are drilled, and the location of the various accessories on the steam drum fixed. The tube holes in the tube sheets are then projected on the plug sheets. The holes in the plug sheets must be exactly opposite those in the tube sheets. It is a good idea to fix the water legs at a fixed distance from each other as soon as the boilers are assembled, and before the rivet holes are drilled or the tube holes on the plug sheet marked out. For this purpose a brace, *G*, is fitted between the water legs. To project the holes on the plug sheet from the tube sheet some such contrivance as that shown in fig. 4 must be used.

A A′ are hollow mandrels passing in the holes in the tube sheets with an easy friction and sliding on a mandrel, *B*. At the ends of the mandrels *A A′* are cones of hard steel, forming points. To project the holes from the tube sheets to the plug sheets it is necessary simply to hammer on the projections *C C′*.

Drilling the holes in the plug sheets.—The whole boiler is then dismounted, and the holes in the plug sheets are drilled. The plug holes are all 3.27 inches in diameter for the back as well as for the front tube sheets. After the holes are drilled in the plug sheets, the surface around the outside of the holes is faired so as to give a good bearing surface for the rings used in forming the joints of the plugs. The faired diameter is about 4.15 inches. The sheets are then sent to the annealing furnace and are carefully annealed.

Riveting.—After annealing, the plates are reassembled and riveted. A hydraulic riveter is used, with a pressure of 80 to 100 tons on the stamp. All the seams are calked. As many as possible are calked on both sides.

Screwing and placing of the stays.—The screw stays are threaded and put in place by the ordinary method. They are riveted at both ends.

First trial of the boiler.—When the boiler is riveted, calked, and the stays riveted, it is tested for the first time before the tubes are put in place. This is done because it is advisable to be sure that all the seams are tight before the tubes are in place, so that any change may be made easily. For the first trial the plug sheets are closed by the regular plugs. The holes for the tubes in the tube sheets are closed by plugs of the same form as those used for the plug sheets, except that they are of a smaller diameter. These plugs are used in succession for all the boilers. The pressure for this trial is about 327 pounds.

Putting the tubes in place.—The tubes are then put in place and expanded in the usual way. There are no stay tubes in the boiler, and all the tubes except those of the bottom row are ordinary tubes. The tubes of the bottom row are Serve tubes. It is best to expand the tubes with wire between the expander and the tubes.

Second trial of the boiler.—After the tubes are in place the boilers are tested as before by hydraulic pressure. This trial is to see that there are no leaks at the joints of the tubes, and to correct any other leaks not corrected after the first trial.

Mounting of the boiler on its supports; mounting the uptakes.—The boilers, assembled two by two, are then mounted on their supports, and the uptakes and smoke pipes mounted. There must be no leaks in the joints of the uptakes or the draft of the boiler will be ruined. To prevent these leaks asbestus is placed between the plates.

Steam trial.—When the boilers are completed they are tried for coal consumption at different rates of combustion. They are then sent to the ship to be mounted on board.

Modifications.—The above process was modified with the boilers of the *Duchayla* by securing the fair bearing of all plates of the boilers before drilling any holes for the tubes either in the tube sheets or the plug sheets.

COMPARATIVE TESTS OF NEW AND OLD STYLE D'ALLEST BOILERS.

The following is the description of several tests made by the French Government of a D'Allest boiler. The description is by Mr. D'Allest. The tests determined the use of these boilers in the navy.

Description of the boiler—The D'Allest boiler is modeled, as far as the circulation of the gases is concerned, after the Scotch boiler. This was with the hope of increasing the small efficiency of the tubulous boiler so as to have it equal to that of the Scotch. The aim has been to give the gases a chance to burn after they have been effectively mixed. Such is the function of the combustion chamber. The distance between two tubes multiplied by the length of a tube will give a section corresponding to the tube section in the ordinary boilers. When the gases leave the nest of tubes they are at a comparatively low temperature, and so occupy a smaller volume. In this boiler these gases would tend to circulate at the top of the vertical row of tubes farthest from the combustion chamber and to leave the tubes at the bottom of this row of tubes without heat. To avoid this a baffle plate is placed at the top of this row, forcing the gases to leave the tubes at the bottom of the side farthest from the combustion chamber. The ratio of the heating to the grate surface is in the design of these boilers about 30; in those of the *Carnot* it was 29.64.

The space occupied by these boilers is as follows: Height, 13 feet 1½ inches; width, 14 feet 5.2 inches; depth, 10 feet 2.1 inches. That is to say, the volume occupied is 0.716 cubic feet per square foot of heating surface.

The working pressure of these boilers is 213.6 pounds, and the weights are as follows:

Total heating surface of one boiler	square feet..	1,340
Weight of boiler without water or fittings	pounds..	20,056
Weight of supports, doors, and grates	do....	5,830
Weight of water in boiler	do....	6,850

This is equivalent to 639 pounds per square foot of grate surface, or 21.6 pounds per square foot of heating surface of the boiler without water, and the weight with water and fittings is 789 pounds per square foot of grate, or 26.7 pounds per square foot of heating surface.

Method of making the trials.—The quantity sought in each of these trials was the evaporative value of the coal in the boiler. The amount of coal burned was increased from 10 to 31 pounds per square foot of grate per hour. The coal was weighed, the water pumped in the boiler was weighed, and the chimney gases were carefully analyzed. The temperature of the gases was taken at several places in the boiler, and the amount of priming shown by the calorimeter in each trial was found to be negligible. The boilers used were old style Lagrafel changed for the trials into the new form. The pressure in the boilers was kept down to about 50 pounds, so as not to endanger the old boiler. To obtain a certain fixed rate of firing of the grates the quantity of coal to be used in each charge was weighed in advance. The furnaces of each boiler were fired in turn, and at regular intervals of ten minutes. The charges of the two boilers, coupled on the same combustion chamber, were five minutes apart. The coal used in all the trials was Cardiff-Cory. The ashes were weighed after each trial, and were found to be about 8 to 10 per cent. The measuring of the feed water was done at the feed tanks which were carefully graduated. Gases were taken from several points in the travel of the gases—under the top of the furnace, above the brick wall in the combustion chamber, and at different points in the nest of tubes. These gases were taken at the same instant, so as to be sure of the circulation of the gases of combustion. The instant chosen was that of firing the grates.

From the trials the volume of air necessary for the combustion of 1 pound of coal was found to be 15.2 cubic feet. The temperature of the gases was taken at different points—in the combustion chamber at *d*, in the uptake at *m*, and at the points in the nests of tubes indicated by *a*, *b*, *e*, *é*. The temperature was measured by means of small bars of copper. These were plunged in known weights of water, and the rise of temperature of the water was noted.

The trials were made on two boilers that had between them 1,076 square feet of heating surface. The ratio of the heating to the grate surface was varied from 35 to 30, and afterwards to 25.

The dimensions of the boiler under trial were:

Grate surface (at ratio of 25)	square feet	43.06
Heating surface of the tubes	do	1,041
Total heating surface	do	1,076
Ratio of heating surface to grate surface		25, 30, 35
Section of side ash-pit doors	square feet	9.04
Section above brick wall	do	9.47
Section of passage for gases entering tubes	do	18
Section of passage for gases leaving tubes	do	9
Section of smoke pipe	do	10.22

Natural draft was used in all trials except the fifth and the sixth.

Results of trials.

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.
Ratio of heating to grate surface	30	35	30	25	30	30
Temperatures:						
a	863	674	726	831	903	924
b	389	554	567	632	506	627
e	382	581	....	545	651	615
e'	693	....	....	....	768	770
d	1,660	990	1,122	1,585	1,083	1,145
m	370	....	466	512	427	510
Length of trial ... hours	6	6.45	6	6	3	3
Total coal burned ... pounds	2,216	3,146	3,326	3,960	2,693	3,326
Weight of residue ... do	176	267	512	336	229	285
Pressure of steam ... do	50	43	50	50	48	43
Temperature of feed	77	77	70.6	80.5	69	70
Coal per square foot of grate	10.31	15.1	15.46	15.3	25	31
Steam per pound of coal	10.67	9.58	9.23	8.97	8.02	8.75
Steam per pound of combustible	11.65	10.47	10.92	9.8	8.763	9.652
Temperature of air	71	79	79	82	77	77
Draft in inches of water:						
At base of stack	....	....	....	.16	....	....
Combustion chamber	....	....	....	.10	....	....
Furnace	....	....	....	.08	....	....
Ash pit	....	....	....	.02	....	....

In the third trial considerable air must have entered the boiler from the other boiler connecting with the combustion chamber, as the central doors to combustion chamber were closed.

RESULTS OF TRIALS (OLD BOILER).

For these trials the same boiler was used with the combustion chamber removed. The sides and the ends of the boiler were bricked up and bafflers were interposed among the tubes to prevent the gases from rising directly to the stack.

The trials were under the auspices of French naval engineers, as were those preceding.

Natural draft was used in all the trials of the old boiler.

	First.	Second.	Third.
Ratio of heating to grate surface	30	30	30
Temperatures:			
a	460	509	510
b	1,006	965	670
e	1,274	1,119	1,005
e'	590	748	656
m	590	568	670
Length of trial ... hours	6	3	3
Pressure of steam ... pounds	50	52.5	53.5
Temperature of feed	73	72.4	74
Coal per square foot of grate	15.55	15.58	20.6
Steam per pound of coal	6.725	5.436	6.526
Temperature of air	77	77	79

In all cases there was a thick black smoke at the time of firing and for some time after that. The flame in the furnace was reddish, showing incomplete combustion.

COMMENTS ON THE PRECEDING TRIALS.

It was noticed that the combustion of the gases was much better in the first trials. The amount of carbonic oxide was much less. It was also noted that the gases lost much more of their heat in the first trials than in the second set of trials. The temperature at the base of the stack (*m*) was less in the first trials. The economical results were so much superior in the first set of trials that no comment seems necessary. It would seem that the presence of a combustion chamber on a tubulous boiler is a good thing.

From the results of the first set of trials it appears that 1 pound of steam can be produced—

At 10.2 pounds per square foot of grate with a weight of 7 pounds.
At 15.3 pounds per square foot of grate with a weight of 4.94 pounds.
At 25 pounds per square foot of grate with a weight of 3.81 pounds.
At 31 pounds per square foot of grate with a weight of 2.86 pounds.

The evaporation per square foot of heating surface is:

At 10.2 pounds per square foot of grate per hour, 39.6 pounds.
At 15.3 pounds per square foot of grate per hour, 55 pounds.
At 25 pounds per square foot of grate per hour, 72.6 pounds.
At 31 pounds per square foot of grate per hour, 96.8 pounds.

CARE AND PRESERVATION OF THE D'ALLEST BOILERS ON THE LIBAN.

The first seagoing vessel to be fitted with D'Allest boilers was the *Liban* of the Fraissenet line. This company is the one that owns the boilers, Mr. D'Allest being the engineer for the company. The D'Allest boilers were placed on the *Liban* in 1890. At that time the engines were changed from compound to triple-expansion by adding a high-pressure cylinder forward of the old engine. The *Liban* has performed the service to the Gold Coast and to Constantinople from Marseilles. Lately she has been put on the Corsican service. I made a trip in her to see the running of the boilers. The results following are what I saw then. The instructions of the manufacturer for the care of the boilers follow.

It was not possible to obtain any figures of the power of the ship that were at all accurate, and, in consequence, there was no possibility of obtaining any results of the boilers' performance. The only results to be obtained were those of the manner of managing the fires and the general care of the boilers.

Raising steam, getting under way.—If the brickwork is newly made it is dried before the fires are lighted for getting under way. This is done by keeping a light fire under the boiler for about four hours. When the brickwork is dry the grates are covered with a layer of coal of as nearly a uniform thickness as possible. Fires are lighted as in the Scotch boilers, and are not forced. The heating of the boiler must be slow. The method of construction makes the danger from unequal expansion of the different tubes very great. In general, about four hours is taken to raise steam, but it is better to allow six hours for this purpose. The fires can be so pushed as to raise steam in one hour, but there will be many leaks at the plugs in the tube sheets and at the tubes. These may take up after the boiler has been under way some time, but there is danger of their becoming so great as to necessitate the drawing of the fires under the boiler. The feed pumps are started only when the steam is raised. The quantity of steam taken to the engines is regulated solely by the throttle valve, and the stop valves are opened wide on all the boilers. This is to insure the same pressure in all the boilers. Generally, when the fires are lighted there will be several leaks at the plugs in the tube sheets, due to the fact that the rings used to make the joint between the plugs and the sheet are not usually good conductors. As soon as the temperature of the boiler is practically the same in all parts these leaks will take up, or they may be stopped at once by setting up on the screws that secure them in place.

Working the fires.—In working the fires great use is made of the dampers at the base of the uptake to regulate the draft. As the steam rises the dampers are closed, and vice versa. When the fires are fresh the dampers are wide open, and as they are burned the dampers are closed. Care is taken with the firing. The layer of coal on the grates must be equal in thickness in all parts to secure the maximum efficiency. This is not so necessary in this boiler as in the Belleville, on account of the bringing together of all the gases before they pass to the uptake. But it is always an advantage to keep the fires in their best condition. Great care is taken to keep the stokers from firing only on the front of the grates, and the thickness of the fires is kept as low as possible without leaving holes in them. The furnaces are charged regularly at intervals of ten minutes, and the furnaces that are coupled together are charged five minutes apart. This rule is not kept by a watch, but it is observed as nearly as may be. The two furnaces that are coupled together (by having a common combustion chamber) are never fired at the same time. The doors to the combustion chamber are kept closed, as it is found that enough air reaches the fires by the ash-pit doors to give good combustion of the coal. Every quarter of an hour or so the combustion chamber is examined by one of the peepholes on the front of the boiler, and care is taken to have it full of flame. Too much air makes the combustion chamber fill and empty of flame. Too little air gives a reddish flame that is easy to recognize.

Feed.—In this boiler, as in all others of the water-tube type, the water must be fresh. Mr. D'Allest makes no claim that his boiler can be worked with salt water, differing from Mr. Belleville, who says that the use of salt water is not dangerous, but requires some special care to be taken. Mr. D'Allest says that the use of salt water is absolutely dangerous, and that the presence of oil or greasy matters in the feed water is equally dangerous. This is due to the amount of tube corrosion that occurs with the use of salt water and from the presence of oils in the boiler. The boiler should be filled in the first place with distilled water, but the use of fresh river water is allowable. For making up waste feed the use of distilled water is necessary. A complete distilling plant is fitted on the *Liban* for this purpose, steam for the distiller being taken from the first receiver, and the steam produced sent to the second receiver.

No oils except mineral oils are used for the piston rod, as well as for the cylinders and the valves. A filter is fitted on the pipe between the air pump and the feed pump, and lime is added to the feed water in the same way as on the *Australien*. Mr. D'Allest gives as the reason for the use of lime in the feed water the quantity of salt water that must inevitably enter the boiler from the condenser. He also says that the lime combines with the oils and grease in the feed water, and that this is precipitated for the most part at the bottom of the rear water leg. The amount of lime used on the *Liban* is about 6 pounds per day per 1,000 I. H. P.

The lime is introduced in a small tank placed abaft the filter, and connected at the top with the discharge of the feed pumps and at the bottom with the main feed tank. A fine sieve is placed near the bottom of the tank to keep the lime from entering the feed water in a solid form.

The feed pumps used are of the Thirion type, which are used on all ships in the French navy not fitted with Belleville boilers. This rule is applicable to the French merchant marine also. Of course, there are exceptions, but this is the standard pump in France.

Use of the blows.—Every eight hours both the surface and the bottom blows are used. The saturation is limited to 3 or 4, and perferably to 2.

General working of the boilers.—In this respect there is no difference to be remarked between these boilers and Scotch boilers, except that the smaller quantity of water in them makes the liability to variations of the steam pressure greater. It is also slightly more difficult to keep the water level. The ordinary check valve is used to regulate the feed water, and the water level has to be watched carefully, although there is no trouble in keeping it constant. Great care must, however, be taken with the firing. This must be regular. It is by care with the fires that the steam pressure is kept constant. If the firing is not regular the pressure may rise beyond the gauge pressure or it may fall very low.

Salt-water leaks in the condenser.—The only legitimate cause of salt water in the boilers is a serious leak in the condenser. This must always be kept clean. If there is a leak in the condenser that can not be repaired before using the boilers, the following precautions must be observed:

The dose of lime must be tripled. Only a part of the boilers will be used, and the fires will be forced under them to give rapid circulation in the tubes and so to prevent the deposit of salt in them. The blows must be used a great deal.

Cleaning tubes.—The tubes being placed behind a water leg, there is great difficulty in sweeping them from the front of the boiler. The hollow stays in the front water leg may be used for a steam jet; this has been tried, but has not given good results.

A plan for sweeping the tubes from the side has been tried on the *Liban* with success, and will be fitted to all future installations of D'Allest boilers for the French service. This consists essentially of a steam tube at the middle of the side of the boiler farthest from the combustion chamber; it has universal joints at both ends, and can be turned through a half circle so as to turn the small tubes fitted on the central tube between each row of tubes through the tubes. Thus the small tubes are so placed as to cover most of the tube surface. By turning on the steam to the central tube each of the small tubes acts as a steam jet, and as it is turned around it serves to sweep the tubes. Holes are fitted in the small tubes pointing in all directions, up, down, and ahead. When the central tube has been turned back and forth five or six times the boiler is practically clean. The soot goes up the chimney for the most part, but some of it settles at the bottom of the uptake and is shoveled from there. This operation takes about three minutes for each boiler, and takes about 4 inches of water from the boiler. The tubes are cleaned every two days.

The tubes may also be cleaned with brushes of a special form. This brush consists of wires seized between two steel sheets and arranged in a layer about three-fourths of an inch thick. It is introduced between two rows of tubes and turned through a right angle. Then it is pushed the length of the tubes. This can be done when the boiler is in use, but only with great difficulty. The sweeping of the tubes with the brush has not given as great satisfaction as the use of the latest scheme for sweeping tubes by steam. When the ship comes into port the tubes are always swept by steam to use up spare steam.

Coming to anchor.—The quantity of coal on the grates is made as small as possible when coming to anchor. All doors are closed, and the boilers are left to cool off as with ordinary boilers. The spare steam is used in sweeping the tubes and in running the winches. The blows are opened wide several times to reduce the concentration as much as possible. In this way it will rarely be found necessary to blow off steam to the condenser.

Cleaning inside of the boiler.—In spite of the use of the filter, there will always be found more or less grease in the boilers, and the tubes may be entirely covered with a scale of grease and lime and salt. To guard against this the boiler is washed every three months with a solution of caustic soda. This washing is very easily done, and often avoids scraping the inside of the boiler. About 11 pounds of caustic soda are introduced in the boilers per ton of water contained. The soda is introduced in a liquid form and by the feed pumps. The concentration of the water in the pumps is not allowed to exceed 1 pound of caustic soda for 7 quarts of water, in order to avoid danger of attacking the brass of the pumps.

When the soda is in the boiler, a light fire is started and kept up for two or three hours, a pressure of 30 to 40 pounds being maintained. Very little steam must be made and the fires are consequently very light. The surface and bottom blows are then used and the boilers are left to cool down. When cold they are completely emptied by the cocks on the bottom of the water legs. It will be found that there is a large amount of oil sent off with the water.

While the boiler is being emptied the manhole plate on the steam drum is taken off and the drum cleaned by simply sweeping it with a broom. It is important that the cleaning be done as soon as the water has left the drum so that any sediment in the drum can be removed while soft.

Some of the tubes are then opened, especially those over the combustion chamber. It is not often that there is any necessity to clean these tubes, but if at all dirty they are cleaned by passing a metallic brush through them. One or two tubes of each row are then opened for inspection, and finally all the tubes of the lowest row are opened and carefully cleaned. The bottom of the water legs is cleaned also.

If there is any salt in any of the tubes it must be removed. The tubes are scraped by means of a special scraper. The water legs are scraped, if any salt is found on them, from the holes opposite the tubes in the front sheet of the boiler.

Repair of the brickwork.—The bricks used in the boiler are not cemented together, but simply placed side by side. Those of the arch above the combustion chamber and those above the upper row of tubes will last almost indefinitely if only left alone. Some of those in the lowest row may be broken when cleaning the boiler, but they can easily be replaced. These bricks are ordinary fire bricks, cost little, and can easily be replaced when broken. The sides of the furnaces and the brick walls are of ordinary fire brick, laid against each other and covered with fire clay.

Preservation of the tubes.—The only tubes that require any special attention are those of the lowest row, immediately above the fires. If they are kept absolutely clean they will not burn out and will not bend. But it is not possible to keep them quite clean. There is always more or less greasy deposit in them. They will then bend with the concavity turned toward the fires, and will leak at the joints in the tube sheets. These leaks are not of any importance, and can be easily stopped by expanding the tubes. Tubes are also sometimes burned. This occurs only with the tubes of the bottom row or to those tubes above the combustion chamber. The breaking of a tube may be foreseen by the presence of small reddish spots on the inside of the tube. If any of these spots are seen when cleaning the tubes, the tubes must be changed. These spots mark places where there will soon be a pocket, and where the tube will be burned. A broken tube has, however, been known to run for forty hours without the size of the break appreciably increasing.

The tubes that best resist the action of the fires are the Serve tubes. They are stronger to resist bending, and consequently less liable to give trouble from leaks; also, even if they are covered with a deposit, they may not burn, as the projections are large enough to conduct the heat from the tube to the water. For these reasons Serve tubes are used exclusively for the lowest row. If the water level gets too low the tubes at the top of the combustion chamber will become empty and therefore more liable to burn. Such an accident happened to the boilers of the *Liban* when they were first tried. Two men were killed. Since that time there have been three rows of tubes over the combustion chamber, and these have more recently been Serve tubes. Where the power of the boiler is too great for that to be expected from the heating surface of the boilers, the more Serve tubes there are the better, as the efficiency of the heating surface is increased by their use. In projected designs of these boilers Serve tubes will be used for all tubes in contact with the flame.

Changing a tube.—If it is a tube of one of the outside rows of tubes that requires changing, it can be reached by the furnace or by the sides of the boiler, and may be cut near the tube sheet. The tube is then drawn out, and also the small ring that remains in the tube sheet, but this last after the rings are deformed by a hammer. If, however, the tube to be removed is in the middle of the nest of tubes, it can not be reached except by the holes in the ends of the boiler opposite the adjacent tubes. The ends of the tube are deformed as usual. The chisel used is of a special form calculated not to injure the boiler sheets. Generally it is sufficient to deform only one end of the tube and to force the tube from the back end by a tube driver. A new tube is put in place and expanded in the ordinary way.

Plugging a tube.—No tube should be plugged by a stay, as the stay, not being in the water, will expand when heated and the plugs will no longer be of any use. It may also be stated that it never pays to plug a tube if there are any spare tubes on the ship. The time required to plug a tube is as great as that required to change the broken one and replace it by a new one. This is aside from the advantage of having a full set of tubes in the boiler. A tube may be plugged by screwing on the face of the tube a plug of the same form as that for the outside sheet of the boiler. The screw that holds the plug in place is held by the plug in this outside sheet.

Leaks at the plugs in boiler front.—There is frequently a case of a leak at one or more of the plugs in the outside plates of the water legs. These are caused by the introduction of a quantity of cold water in the boiler, or by the too rapid cooling or heating of the boiler. The rings of asbestus used in a large measure to make these joints are not good conductors of heat, and the temperature of the plugs is not the same as that of the boiler when that of the boiler is changing. The use of the improved rings of copper and lead has done away with most of the leaking at the plugs. If there is any leak at these joints, all that is necessary to do is to wait till the boiler has attained a fixed temperature, after which the leak will stop.

Boilers not in use.—When a boiler is not to be used for some time it is filled completely, after being washed, as already described. The water in the boiler is fresh water, with about 22 pounds of caustic soda added per ton of water. This is to avoid all internal corrosion. All doors are tightly closed to avoid drafts in the boiler, and so to avoid any external corrosion. For this reason it is best to cover the smoke pipe.

General instructions.—The boilers must receive only fresh water to fill to working level, and to make up waste feed. Consequently, loss of fresh water from the boiler must be guarded against, and the condenser must be in good condition. A distiller must be used, and lime be added to the feed to destroy the effects of the oils and salts in the water. This will also reduce "priming." A filter to remove the grease from the feed water is a necessity. Only the best mineral oil can be used in the cylinders. In starting the fires, they should not be forced at all. They should not be pushed until the engines are well under way. While under way, the grates should be covered regularly and with as thin a layer as possible. Care must be taken not to charge the front of the grate to the exclusion of the rest. When stopping firing, there should not be a large amount of coal on the grate, and the doors should be closed, and the boiler cooled down as slowly as possible. The two furnaces coupled together on the same combustion chamber must never be fired at the same time. The tubes of the lowest row must always be kept absolutely clean. Every three months or so, if the boiler is in constant use, the washing described must take place. The brickwork must be kept in good condition and all broken or lost parts replaced as soon as possible. The arch above the combustion chamber must be kept in good condition. With proper care in managing the firing, the safety valves will never open. All that is required is proper care when getting under way and coming to anchor.

Specialties in the design of the boiler.—No solid drawn tubes have been used. The boilers have zinc plates in all accessible parts. The quantity is fixed at about two pounds per 1,000 square feet of heating surface. The use of zinc plates is found to be a very good thing in these particular boilers. Mr. D'Allest said that it was absolutely essential, and that with it the boiler would last double the time it would without it. The plates are put in a box of the same form as that used in our Navy. Two plates are put at the bottom of each water leg, and two are placed in the steam drum. Those in the water leg are placed on the outside sheets, so as not to interfere with the circulation of the water in the tubes. The plates in the rear leg are not placed at the bottom, but opposite the second row of tubes from the bottom.

In placing these boilers in a ship, space is always left at the sides for getting at the tube nest. This space does not exceed that necessary for the uptakes.

OFFICIAL TRIALS OF THE D'ALLEST BOILERS OF THE BOUVINES.

Natural draft was used in the first two trials of these boilers. In the last two trials the draft was assisted by blowers. The third and fourth trials were in succession. The grates were not cleaned between these trials, which were the official trials for the acceptance of the boilers.

The ratio between the heating and grate surface was 30:

	First trial.	Second trial.	Third trial.	Fourth trial.
Length of trial.....hours..	6	12	3	3
Coal burned per square foot of grate.....pounds..	20.5	12.3	24.5	30.7
Temperature of feed.....	119.5	123.5	125	127
Pressure of steam.....pounds..	185	185	185.6	185.6
Evaporation per pound coal.....do....	9.8	10.068	9.501	9.235

TRIALS OF THE JEMMAPES.

The engines of the *Jemmapes* were designed for 8,400 I. H. P. with forced draft, but the official trials gave 9,250, and this with a consumption of 2.03 pounds per I. H. P. The coal burned per square foot of grate was 29.66 pounds.

On another of the trials the cost of an I. H. P. was (7,711 I. H. P.) 1.802 pounds. The coal per square foot of grate in this trial was 22.05 pounds per hour. The second trial was of twelve and the first of six hours' duration. The results of the other trials were not public when I left France.

All D'Allest boilers are designed by the inventor, though most of them are manufactured by other firms than the one of which he is engineer.

THE NICLAUSSE BOILERS.

These boilers are on the principle of the Field tubes. Each of the evaporating tubes is fixed at one end in a water leg with two divisions, one for steam and one for water. To carry the water from the water side of the leg there is a tube fitted connecting the water leg to the end of the evaporating tube. The water then turns in the tube and passes through the outside or evaporating tube to the steam side of the water leg.

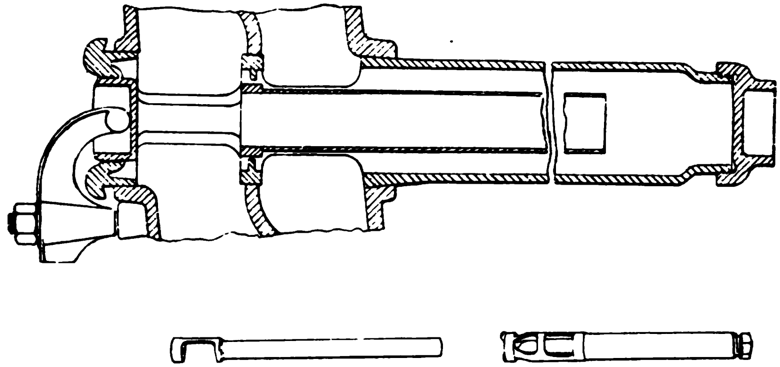

Fig. 5.—SECTION AND VIEWS OF EVAPORATING AND CIRCULATING TUBES, NICLAUSSE BOILER.

The features of the boiler that are peculiar are the way of making the joints between the tubes and the water leg, the form of the tubes and the water leg, and the kind of nappe on the top of the steam side of the water leg at the point where the steam enters the drum. The tubes are all of welded steel and are reenforced at the joints, which are always conical, whether the joints are screw or not.

The joint between the evaporating tube and the water leg is a flat, conical one at both the outside sheets of the water leg. The joint at the partition between the steam and the water sides of the leg is a loose one, not water-tight. The cones forming the joints to the outside sheets are shrunk on the tubes and are then turned to the required diameters. The cones are not exactly the same, as in placing the tube in place the cone on the inside sheet of the water leg begins to bear last. The cone on the tube for the outside sheet is made comparatively flexible by being secured at one end only. The inside diameter of the outside cone is made the same as the outside diameter of the inside cone. The tube can be drawn out and it is in equilibrium for the steam pressure. The tube does not tend to leave the water leg. Nevertheless a safety bar is screwed on the outside of the water leg to insure the tube staying in place in case of shocks, etc.

The end of the evaporating tube is in the form of a lantern with a section at the middle partition of the water leg that is approximately the same as that of the tube. The diameter of the hole in this partition is very slightly larger than that of the tube at the inner cone.

The inner tube, which serves for the circulation of the water to the end of the evaporating tube, is screwed into the outside of the latter. The joint is conical. The tube has a small lantern to form the junction between the two parts of the tube. The tubes are shown in the accompanying scketches.

The nappe at the top of the steam side of the water leg is made conical with the large diameter at the top of the nappe so as to give a small velocity to the steam when it is entering the drum at the top of the boiler. The disposition of the nappe gives dry steam at rapid firing of the boiler.

The collectors are of malleable iron, and there is a separate collector for each pair of vertical rows of tubes. The tubes are arranged staggered. This is to give the gases of combustion a zigzag course through the tubes. Space is left between the collectors to sweep the tubes by steam. The joints between the collectors and the drum are conical, and the drum is fastened to the collectors by bolts to make the joints tight. The collectors are united at their lower part to enable the blowing down under pressure. There are pipes to make this connection.

The feed water is introduced in the upper drum in a stream going in the steam. No ejector is fitted to the boiler, and no part of the boiler is particularly apt to have more sediment than another, unless it be the bottom of the collectors where the bottom blows are placed.

It seems to me that there is too much machine work on the tubes. This makes the boiler costly. The conical joints are satisfactory and appear to be good. I think, however, that the joint between the collector and the drum might as well be of the ordinary form.

The circulation of the feed water in the boiler depends entirely on the difference in weight of the different columns in the water leg. The higher the boiler the better the circulation. The circulation is, however, good. The economy of the boiler is not great at high rates of combustion. I think if a combustion chamber were fitted the economy would be as great as that of the D'Allest boiler, if not superior.

The great advantage of this boiler is the freedom of expansion of the tubes and the consequent ease of forcing. When forced the tubes bend, and I suppose that they will wear out sooner than if Serve tubes were used for the bottom row. The inner tube is not supported and will sag so as to bear on the evaporating tube, but it is in a constant state of vibration, and this would not necessarily be an objection of weight.

The floor space occupied for a given heating surface is here reduced to a minimum. The tubes are slightly inclined, but the ends of the boiler are vertical.

All work on this boiler can be done from the front of the boiler, and no space is necessary at the sides or back.

The boiler does not work regularly enough, due to the small amount of water in it. But it can be worked without any auxiliaries such as are needed on the Belleville boiler, and will give fair satisfaction even when used alone without Scotch boilers.

It is very easy to repair and the repairs are quickly made.

The inventor claims the advantages of small weight and good utilization of coal in addition to those given, but the weight is slightly greater than that of the D'Allest boiler, and is much greater than that of almost any type of bent-tube boilers in use in this country. The weight may be reduced, but it is already a great deal less than that of the Scotch boilers whose place it is trying to take. The advantage of using straight tubes, lying in the ease of cleaning and repair, overcomes the advantage of the smaller weight of the bent-tube boilers. The inventor claims that the impossibility of emptying the tubes except when cleaning the boiler is a great advantage. He says that this retains whatever deposits may be made in the tubes in a soft, muddy state that facilitates the cleaning wonderfully.

The tubes and all other parts of the boiler are made interchangeable. The boiler is in small elements and can be taken out of a ship with ease. Any part that requires replacing can be changed without great cost, owing to its small size.

Care of the boilers.—The inspections of the tubes will be more or less frequent according to the quality of the water used and the amount of work done by the boiler. When the boilers are first used the tubes should be examined frequently, especially those of the lowest row. This is to determine when and how often the boiler should be cleaned.

The part of the collectors that is most liable to become dirty with use is the upper part. Cases have occurred when the deposits in the top of the collectors have stopped the circulation, and tubes have been burned out. The boiler should not be emptied except when about to clean it, as the deposits would otherwise become hard and much more difficult to remove. The deposits will be found to be in most cases in the circulating tubes to the exclusion of the evaporating tubes. Both the surface and the bottom blows should be used at least once a day. The cocks are very liable to get choked, and must be frequently examined to see that this does not occur.

To clean a tube it is necessary to remove the safety bar and to unscrew the inner tube. These tubes contain the deposits, which are removed by washing, or, if it is necessary, by using a metallic sponge. A special key is furnished to prevent the turning of the outside tube when the inner one is unscrewed. This turning of the outside tube is not frequent. If the evaporating tube needs cleaning, it can be done either in the boiler or it can be drawn, the screw plug at the back taken off, and the tube cleaned outside the boiler. To draw the evaporating tube, it is started with a hand hammer. Before replacing a tube in the boiler the joints are carefully cleaned and covered with grease. In general all the tubes of a boiler are cleaned at the same time, commencing with the bottom row in removing them, and with those of the top row in replacing them. While the tubes are out of the boiler the collectors are wiped and cleaned. The tubes are cleaned on the outside by a steam sweep that is placed in the openings between the collectors. They are swept in horizontal rows, beginning at the top of the boiler.

Other parts of the boiler requiring to be examined from time to time are the feed pipe and the fittings of the drums. Boxes to collect the deposits from the feed water are put in the drum, and must be cleaned frequently. The feed water is regulated entirely by a check valve placed on the boiler. Any sudden increase in pressure is stopped by use of more feed water.

In case of leaks it is not well to screw up on the nuts on the safety bars. This may break the joint and cause an explosion of the boiler. All leaks are the result of dirt in the joint, and no leak can be stopped without remaking the joint. If the joints are properly made in the first place, no leaks will appear during the working of the boiler. During stops the ash-pit doors are closed, but neither the furnace doors nor those to the tubes are opened. More especially if the feed water falls below the bottom of the glass should these doors be closed. In this case the fires must be drawn at once unless the cause of the lack of water is immediately discovered.

When the boilers are no longer required the blows are used and the water level is raised to the top of the glass. The fires must be pushed to the back of the grate or even drawn. Sudden changes of temperature will have no bad effects. When a boiler is not to be used for some time it is cleaned and then completely filled with water.

EXTRACT FROM A CIRCULAR FROM THE MINISTER OF MARINE CONCERNING THE USE OF LIME IN THE FEED WATER.

According to the opinion of the inspector-general of engineers it is best to add lime to the feed water after it leaves the filter, as, for example, in the feed tank, but care must be taken to prevent the lime from settling at the bottom of the tanks. It is best, on the contrary, that the lime should go to the boiler and mix with the water there and be dissolved. In certain cases it may be advantageous to introduce the lime directly into the boilers. In this way it would not pass through the feed pumps. As to the amount of lime to use, it is better not to use too much, and for this reason it is essential to determine at least once a watch the acid or basic condition of the water in the boilers by using litmus paper, or in some other simple way. Until further orders the amount of lime to be delivered will be 1.7 pounds per ton of coal in the bunkers. But it is understood that the amount to be used will vary so that the water in the boilers will never have any trace of acidity, but give a good basic reaction.

COMPARISON OF THE ENGINES AND BOILERS OF THE BUGEAUD, CHASSELOUP-LAUBAT, AND FRIANT FITTED WITH BELLEVILLE, D'ALLEST, AND NICLAUSSE BOILERS.

These ships are exactly the same except in the fire rooms. They were intended to give a comparison of the three types of tubulous boilers used on them. The engines of these ships all come from the shops of the Forges et Chantiers de la Méditerranée, at Havre, and are the same in all particulars. The boilers come from the inventors of them. The hulls of the *Bugeaud* and *Chasseloup-Laubat* come from the navy-yard at Cherbourg; that of the *Friant* from the navy-yard at Brest. They are identically the same. The ships are second-class cruisers of 3,725 tons displacement. Length, 308 feet; beam, 43 feet 6 inches; depth below main deck, 29 feet 6 inches; draught, 17 feet 6 inches at midship section and 20 feet 8 inches aft; area of the immersed midship section 697 square feet. The lines of these ships are derived from those of *Davout* that gave satisfaction. The ships are designed to give a speed of 19 knots with forced draft of 1 inch water pressure in the fire rooms. They have each a crew of 356 men, all told, and were all launched in 1893. The designed power of the engines at forced draft was 9,000 I. H. P.

The contract calls for the following powers and dimensions of engines and boilers for the three ships:

The total power of the main engines at the forced-draft trial is 8,650 I. H. P. If the number of revolutions is less than 135 it will be increased to that figure. If at 135 revolutions the power (with a screw given by the Government) is less than 9,000 I. H. P. the dimensions of the screw may be changed to increase the power. The price of the engines of each ship is 1,314,700 francs. The price of the boilers is for the Belleville boilers of the *Bugeaud*, 603,570 francs; for the D'Allest boilers of the *Chasseloup-Laubat*, 503,300 francs; for the Niclausse boilers of the *Friant*, 615,170 francs. The total weight of all machinery is to be (boilers and water included), *Bugeaud*, 801 tons; *Chasseloup-Laubat*, 757 tons; *Friant*, 760 tons. For any excess in weight within 5 tons a penalty of 1,000 francs per ton is charged; for excess within 10 tons, 2,000 francs per ton is charged; for excess within 15 tons, 5,000 francs per ton is charged; if in excess above 15 tons, the machinery may be rejected.

There are to be the following trials:

One forced-draft trial of four hours, with a combustion of not more than 30.7 pounds per square foot of grate. The power on this trial must be as much as 9,000 I. H. P. for all machinery. If on this trial the consumption of coal per square foot of grate is as great as 27.7 pounds, no second forced-draft trial is necessary; if it is not, there will be a forced-draft trial with a consumption of coal at least equal to 30.7 pounds per square foot of grate per hour.

There will be a trial of twenty-four hours, of which four hours will be at about 6,000 I. H. P., two hours at 9,000 I. H. P., and eighteen hours at 6,000 I. H. P. This last period may be taken at any part of the trial. The grates will be clean at the commencement of the trial, and the coal burned per I. H. P. will be from 1.76 to 1.98 pounds per hour.

There will also be three trials of six hours each with powers of 7,000, 3,500, and 1,500, I. H. P., and with coal consumptions of 1.87 to 2.09 pounds, 1.54 to 1.76 pounds, and 1.65 to 1.87 pounds, respectively. If the consumption exceeds 2.21 pounds on the first trial, or 1.98 pounds on either of the others, the machinery may be rejected.

In each of the trials where the consumption is fixed any excess involves a fine of 100 francs for each hundredth pound. There is an equal premium for all saving above the figures given. No premium is given for any excess of power, and no penalty is imposed for a failure to arrive at the required power. It is understood that the machinery will be rejected if it fails to reach the required power.

Detailed weights in the engine room.

	Tons.
Engines complete (with reducing valves)	246.9
Line shafting	51
Propellers	12
Bilge pumps	1.6
Piping and water valves	49
Floor plates and ladders	8.6
Tools	5.2
Spare parts	8
Evaporators	3
Engine-room ventilators	2.4
Water in condensers and pipes	10
Water in tanks	5
Lime tanks	1.3
Total weights in engine room	425

For the *Bugeaud* (Belleville) the weight of water in tanks is increased to 16 tons, making the total weight for this ship 436 tons.

Detailed weights of boilers.

	D'Allest.	Belleville.	Niclausse.
Boilers proper	131.3	273.3	146.5
Uptakes	67		56
Accessories	11.8		6.6
Grates and fittings	19.1		18.3
Tools and spare parts	5.6	8.1	7.6
Feed pumps	5.2	11.4	5.2
Tanks	4	8	4
Smoke pipes	17	23.5	19.8
Floor plates and ladders	9	9	9
Fire-room ventilators	9	9	9
Air compressor	....	2.5	....
Separator	....	5.2	....
Water in boilers	53	16	53
Total of fire rooms	332	365	335
Total of all machinery	757	891	760

The difference in the weights of smoke pipes is due to the fact that the different contractors did not include the same height of pipe in their estimates, and the weights given do not include the same portion of the pipes.

The table is taken from the contract weights, and is not the same as the weights actually in the ships. The weight of the boilers of the *Friant* are given by the contractors as follows:

	Tons.
Boilers alone	202.61
Uptakes	10.76
Water in boilers	46.18
Tools and spare parts	7.26
Joint to smoke pipes	5.15
Total of parts mentioned	271.96
Adding weights of parts not included in above, as in contract weights:	
Feed pumps	5.2
Tanks	4.5
Smoke pipes	19.8
Floor plates and ladders	9
Ventilators	9
We would have a total weight in actual fire room	329

The increase in weight of the boiler proper and the decrease in weight of uptake, together with the decrease in the weight of water in boiler, are to be noted. The total weight remains about the same as before.

Dimensions of the boilers.

	D'Allest.	Belleville	Niclausse.
Number of fire rooms	3	3	3
Number of boilers	20	24	20
Number of furnaces per boiler	1	1	1
Length of grate	6 ft. 8 in.	4 ft. 7 in.	6 ft. 8 in.
Width of grate	5 ft. 4½ in.	7 ft.	6 ft.
Total grate surface .... square feet	732	755-2	782-8
Total heating surface .... do	19,451	21,594	23,338
Ratio heating to grate surface	26.6	28.6	29.8
Outside diameter of tubes .... inches	3.25	3.23	3.23
Inside diameter of tubes .... do	2.91	2.86, 2.60	2.97
Length of tubes	7 ft. 9 in.	6 ft. 4 in.	5 ft. 8⅛ in.
Diameter of circulating tubes .... inches	....	....	$1\frac{9}{16}$
Number of tubes in vertical row	10	9	9
Weight of water .... tons	53	16.2	46.2
Volume of steam space .... cubic feet	1,879	784	830
Boiler pressure .... pounds	214	242	214
Pressure at engines .... do	170	170	170

The excess in weight of the Belleville boilers is partly explained by the short grates on those boilers. The Niclausse boilers have a much larger heating surface than the D'Allest for the same power, and considerably more than the Belleville. This is while retaining a weight only equal to that required for the D'Allest boilers and while having 40 tons less weight than the Belleville.

The ease with which the D'Allest boilers can be forced makes them far the most powerful boilers in an emergency of the three sets given.

There are two air pumps for each engine, with diameters of 24.6 inches and stroke of 15.75 inches. The number of turns of the air pump was designed at 168 at full power. The air pump turns the circulating pump also. The diameter of the turbine is 47.2 inches.

The ratio of the final volume occupied by the steam to its volume on admission to H. P. cylinder is 7.4129.

Only fresh water is to be used for feed. A filter is placed between the engines and the boilers, and there is an apparatus for adding lime to the feed water. There are two feed pumps for each fire room, of which one is large enough to supply the boilers. There are two evaporators to supply waste feed. To make the working of the fires easier, there is a damper at the base of each smokestack near each boiler.

VII.

NAVAL MANŒUVRES OF 1894.

By Lieut. E. B. BARRY, United States Navy,
Staff Intelligence Officer.

THE BRITISH MANŒUVRES.

MOBILIZATION.

The mobilization of the ships to be employed for the naval manœuvres was ordered originally for July 11, 1894, but owing to the difficulty of obtaining the necessary men was postponed to the 18th. By this postponement the crews of the *Orlando* and other vessels recently paid off on the Australian station, some 800 men in all, became available.

An Admiralty order of June 30 directed that all ranks and ratings proceeding on leave were to be informed that they would be recalled for the partial mobilization of the fleet.

July 1 the naval authorities at Portsmouth were furnished with an official list of the ships to be commissioned and mobilized at that port on July 18. The list comprised 2 battleships, 9 cruisers, 4 small vessels, and 11 torpedo boats.

July 4 an order was issued directing the commissioning on July 18 of 20 war vessels from the Medway Fleet Reserve. The commander in chief at the Nore forwarded requisitions to the Portsmouth and Devonport depots for the selection of over 1,000 petty officers and men to fill up the complements. About 500 men were sent from Devonport and 600 from Portsmouth.* The Admiralty approved of the embarkation, during twenty-eight days of the manœuvres, of 250 first-class and 250 second-class Royal Naval Reserve men, to be carried in addition to the complements previously fixed for the vessels.

The paid-off crew of the battleship *Nile* was sent home from Malta, and immediately upon arrival the men were detailed for service on board the vessels of the mobilized fleet. The Sheerness School of Gunnery was closed temporarily, and 700 petty officers and men were drafted to the Medway Fleet. Complements of active service seamen (including coast-guard men) were reduced from the seagoing allowance; 10 from each battleship and first-class cruiser, and 5 from each second-class cruiser. The English press was loud in its outcries regarding the want of men, yet the complements of harbor ships were not drawn upon, and in addition to these there remained at Portsmouth and Devonport 733 seamen and 548 men of the engineers' force. The nonembarking section and 282 men of the embarking section of the coast guard were not called out. In addition there were 5,400 marines left in barracks.

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* In all, 1,395 men were sent to Chatham from Portsmouth and Devonport.

Partial mobilization differs from full or complete mobilization in that the reserve personnel is not ordered to embark, while in the latter case each ship instead of being fully manned from the active service would have her complement composed of a proportion of active service men and reserves.

Station.	Coast defense.	Battle-ships.	Cruisers.	Small craft.	Torpedo boats.	Total.
I. Vessels commissioned for the manœuvres.						
1. The Nore (Chatham and Sheerness)		1	11	9	7	28
2. Portsmouth			7	1	11	19
3. Devonport			5	1	5	11
Total		1	23	11	23	58
II. Vessels already in commission taking part in manœuvres.						
1. The Nore				3		3
2. Portsmouth				3		3
3. Devonport		1	1	3	1	6
Total		1	1	9	1	12
III. Channel squadron taking part in manœuvres.						
English Channel, etc		4	3	2		9
IV. Coast and port-guard vessels furnished with full crews.						
1. The Nore		1	1	1		3
2. Portsmouth		2	2	2		6
3. Devonport	1	3	3	1		8
Total	1	6	6	4		17
Grand total	1	12	33	26	24	96

Personnel of manœuvre fleet.

Men for vessels commissioned	9,009
Men for coast and port-guard vessels (extra)	2,645
Royal Naval Reserve	535
Channel Squadron and other vessels	9,199
Total	21,388

Table showing strength of mobilized fleet, 1890-1894.

Class of ship.	1890.		1891.		1892.		1893.		1894.	
	No.	Displacement.	No.	Displacement.	No.	Displacement.	No.	Displacement.	No.	Displacement.
Battleship:		*Tons.*		*Tons.*		*Tons.*		*Tons.*		*Tons.*
First class	4	41,800	6	52,270	6	66,550	4	45,650	6	77,700
Second class	3	29,770	3	27,970	4	37,300	3	27,990	5	49,460
Third class	6	37,070	7	43,710	7	45,060	4	25,050	1	6,200
Coast-defense ships	7	28,030	2	8,880	6	24,470	1	5,400	1	5,400
Cruisers	26	117,370	23	78,565	26	99,405	33	130,875	33	145,825
Small and special-service vessels	10	13,380	14	16,305	17	18,235	20	20,770	26	18,628
Torpedo boats	24	2,222	20	1,752	27	2,361	24	2,222	24	2,149
Total	80	269,642	75	229,452	93	293,381	89	257,957	96	305,362
Total officers and men employed	18,860		[1] 16,908		[2] 20,370		18,725		20,853	

[1] 469 R. N. R. men not included. [2] 535 R. N. R. men not included.

The *Dreadnought* and *Pallas*, not included in the above, were assigned to special services.

The following general orders, etc., were issued by the Admiralty for the information of both sides:

Red and Blue are two opposing naval forces; the composition of each is known to both sides. For the purposes of assembly, preliminary cruises, etc., each force will be divided into two fleets, viz: "*A*" and "*B*," *Red* fleets; "C" and "D," Blue fleets.

The limits of the manœuvre area will be: On the north, 57° N. latitude; on the south, 47° 20′ N. latitude; on the east, the western coast of Great Britain and the south coast to longitude 4° W.; on the west, 15° W. longitude. (*See* chart.)

There will be a "forbidden belt" which must not be crossed after the termination of the preliminary cruise by vessels of either side. This belt will be between a line drawn from Brow Head to latitude 47° 20′ N., longitude 15° W., and another line parallel to the first, drawn from the point at which the ninth meridian cuts the south coast of Ireland to latitude 47° 20′ N.

On the south coast of England: From Stoke Point to the Lizard, both included, *Red.*

On the west coast of Great Britain: From Rhossili Point to St. Bees Head, both included, with Anglesea and Holyhead Island, Blue.

On the east coast of Ireland: From White Head to Orlock Point, both included, *Red.* From Clogher Head to Galley Head, both included, Blue.

On the west coast of Ireland: From Brow Head to Recnada Point, both included, *Red.* From Bunbane to Broadhaven Bay, both included, Blue.

The Scilly Isles, the Isle of Man, the Scotch Islands, and the remaining coasts of the United Kingdom not specified as being *Red* or Blue are "neutral." For the purposes of these manœuvres "neutral" waters extend 1 mile beyond the 5-fathom line off "neutral" territory.

The *Red* ports, Belfast, Bantry Bay, Falmouth and its roads, are assumed to be fortified, and *Red* ships in them are not open to attack by ships, but no *Red* port gives security to ships against torpedo-boat attack, except the portion of Belfast Lough to the westward of a line joining Carrickfergus Castle and Cultra Mill Stump.

The Blue ports, Queenstown and the Shannon, are assumed to be fortified, and Blue ships in them are not open to attack of any kind. *Red* torpedo boats in Belfast Harbor are secure against attack. Blue torpedo boats in Milford Haven, Holyhead, Piel (near Barrow-in-Furness), Queenstown, Kingstown, and Waterford are secure against attack. Other ports give no protection.

Ships of groups (1) or (2) going into Milford Haven will be out of action for twenty-four hours, but BLUE ships already out of action from other causes may go there and stay until the term for which they are out of action expires.

Before the preliminary cruise the "*A*" *Red* fleet will assemble at Portland, the "*B*" *Red* fleet at Berehaven, the "C" BLUE fleet at Torbay, the "D" BLUE fleet at Milford Haven.

The *Red* torpedo boats, with the ship to be placed at the *Red* torpedo-boat station, will assemble at Portland. The BLUE torpedo boats, with the ships to be placed at the BLUE torpedo-boat stations, will assemble at Falmouth. Mobilized and newly commissioned ships not coming from Portsmouth when ordered to put to sea are to proceed direct to their place of assembly without calling at Spithead.

Torpedo boats on commissioning are to have sufficient trials to establish their efficiency and readiness for service. When ordered to put to sea, they are to proceed as most convenient, but with as little delay as possible, to their places of assembly, where they will receive the necessary orders for proceeding to their respective stations. The vessels of one side are not to reconnoiter the ports assigned to the other, unless permission is given, until "hostilities" begin.

When in all respects ready, the several fleets are to put to sea for one week's exercise, after which each force will proceed to its place of second assembly, viz: The "*A*" *Red* fleet will assemble at Falmouth, the "*B*" *Red* fleet will assemble at Berehaven, the "C" BLUE fleet will assemble at Queenstown, the "D" BLUE fleet will assemble in the Shannon.

The several fleets will be directed by telegraph to put to sea and carry out the orders issued for the guidance of each. The total time occupied by the manœuvres will not exceed ten days, counting from the hour of beginning. At the conclusion of the manœuvres target practice as due will be carried out. Should ships require coal for this purpose, the places to which they are to repair will be selected by the officers commanding fleets. Only one-fourth of the quarterly allowance of ammunition is to be expended from the heavy, light, quick-firing, and machine guns of the mobilized ships, and this proportion is not to be fired until the termination of the manœuvres, when the guns' crews are accustomed to their work, so that it may be expended to the best advantage. Practice from aiming rifles fitted to guns is, if possible, to be carried out before the guns themselves are actually fired, such aiming-rifle practice being carried out at sea, with the ships steaming past the target.

When the target practice has been completed, the ships will assemble for inspection prior to dispersion at the following places: "*A*" *Red* fleet at Spithead, "*B*" *Red* fleet in Torbay, "C" BLUE fleet at Portland, "D" BLUE fleet in Plymouth Sound. The inspection being completed, they are to return to their respective ports of commissioning. The *Red* torpedo-boat squadron will assemble at Spithead and the BLUE in Plymouth Sound, and the boats after inspection will return under suitable escort to their ports of commissioning.

Should the Admiralty desire to communicate with the fleets during the progress of hostilities, and their instructions be conveyed by a ship attached to either of the opposing forces, or by any other ship, such ship is to display the signal "A. K. H." It will thus be known that she is acting under Admiralty orders, or is about to deliver dispatches or telegrams, or to signal orders received from the Admiralty, and the respective admirals and senior officers are to take the necessary steps to insure that the orders so communicated are forwarded and acted on without delay. The ship conveying such orders, on meeting other vessels, must exercise discretion as to communicating the nature of the orders she is intrusted with, should no instruction on the point be given to her commanding officer. If the commanding officer of one vessel sights another flying the signal "A. K. H.," he is at once to close her, so as to place himself at a convenient distance for communicating by signal, should it be necessary to do so.

Reports on the manœuvre operations are to be confined to that subject. The following officers have been nominated to act as umpires: Vice-Admiral Sir W. J. Hunt Grubbe, Vice-Admiral J. E. Erskine, and Rear-Admiral H. G. Andoe, who will meet at 36, Spring Gardens, where all claims and statements for their consideration should be sent, addressed to "The Secretary of the Umpires." Claims, etc., are to be sent in as soon as possible after the events to which they refer. They should be accompanied by extracts from the ship's log or signal log, by track charts when suitable, or by other documentary evidence likely to assist the umpires in arriving at a decision. Claims, etc., sent by telegraph must be followed by the same claim, etc., sent by the first post.

COMPOSITION OF THE FLEETS.

Red side.

Vice-Admiral R. O'B. Fitz Roy, C. B., commanding *Red* side and in immediate command of "*A*" fleet.

First place of assembly, Portland; second place of assembly, Falmouth.

"A" Fleet.

Ships.	Class.	Date of completion.	Displacement.	Guns, main battery.	Maximum speed.	Complement.	Value assigned for manœuvres.
Group 1.					*Knots.*		
Royal Sovereign (flag)	Battleship	1892	14,250	14	18	728	5
Resolution	do	1893	14,150	14	17.9	713	5
Devastation	do	1873	9,330	4	14	356	4
Blenheim[1]	Protected cruiser, first class.	1892	9,000	12	21.6	613	4
Endymion[1]	do	1894	7,350	12	20	544	4
Bonaventure[1]	do	1894	4,360	10	19.5	329	4
Group 2.							
Brilliant	Protected cruiser, second class.	1893	3,600	8	19.7	325	1
Sappho	do	1893	3,400	8	20.5	325	1
Scylla	do	1893	3,400	8	20.6	325	1
Terpsichore	do	1892	3,400	8	20	325	1
Thetis	do	1892	3,400	8	20	325	1
Rainbow	do	1892	3,600	8	19.7	325	1
Group 3.							
Speedy	Torpedo vessel	1894	810	2	20.2	91	....
Circe	do	1894	810	2	19.2	91	....
Renard	do	1894	810	2	19.2	91	....
Seagull	do	1890	735	2	20	85	....
Speedwell	do	1890	735	2	20	91	....
Antelope	do	1894	810	2	19.2	91	....
Rattlesnake	do	1887	550	1	18.5	61	....
Spider	do	1891	525	1	19	61	....
Havock	Torpedo boat, first class.	1894	220	1	26.7	40	....
Hornet	do	1894	220	1	28	40	....

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[1] Cruisers classed as battleships for manœuvre purposes.

"B" Fleet.

Rear-Admiral ALFRED T. DALE, commanding.

First place of assembly, Berehaven; second place of assembly, Berehaven.

Ships.	Class.	Date of completion.	Displacement.	Guns, main battery.	Maximum speed.	Complement.	Value assigned for manœuvres.
GROUP 1.					*Knots.*		
Empress of India (flag)	Battleship	1893	14,150	14	18	728	5
Repulse	do	1894	14,150	14	17.5	713	5
Conqueror	do	1882	6,200	6	15.3	305	4
Astræa[1]	Protected cruiser, first class.	1894	4,360	8	19.7	325	4
Theseus[1]	do	1894	7,350	12	20	560	4
Gibraltar[1]	do	1894	7,750	12	19.7	560	4
GROUP 2.							
Latona	Protected cruiser, second class.	1891	3,400	8	20	325	1
Andromache	do	1891	3,400	8	20	325	1
Medea	do	1890	2,800	6	19	216	1
Medusa	do	1890	2,800	6	19	216	1
Pearl	do	1892	2,575	8	19	190	1
Barrosa	do	1890	1,580	6	16.5	156	1
GROUP 3.							
Alarm	Torpedo vessel	1894	810	2	19.6	91	....
Onyx	do	1894	810	2	19.2	91	....
Sheldrake	do	1890	735	2	20	91	....
Gossamer	do	1891	735	2	19.8	93	....

[1] Cruisers classed as battleships for manœuvre purposes.

Torpedo-boat Flotilla.

First place of assembly, Portland; second place of assembly, Belfast.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
DEPOT SHIP.					*Knots.*		
Rupert	Coast-defense vessel.	1874	5,440	....	14	237	....
TORPEDO BOATS.							
No. 45	2	1887	60	1	16.5	15	....
No. 52	2	1886	60	2	15-16	15	....
No. 53 (divisional)	2	1886	60	2	15-16	15	....
No. 80	1	1887	105	2	17	15	....
No. 85	1	1889	85	2	17	15	....
No. 87	1	1889	85	2	17	15	....

Blue Side.

Rear-Admiral E. H. Seymour, C. B., commanding Blue Side and in immediate command of "C" fleet.

First place of assembly, Torbay; second place of assembly, Queenstown.

"C" Fleet.

Ships.	Class.	Date of completion.	Displacement.	Guns, main battery.	Maximum speed.	Complement.	Value assigned for manœuvres.
Group 1.					*Knots.*		
Alexandra (flag)	Battleship	1877	9,490	18	14.3	674	5
Barfleur	do	1894	10,500	14	18.5	620	5
Benbow	do	1888	10,630	12	16.7	480	5
Inflexible	do	1881	11,880	12	12.8	460	4
Colossus	do	1886	9,420	9	14.2	474	4
Edinburgh	do	1886	9,420	9	14.2	450	4
St. George[1]	Protected cruiser, first class.	1894	7,750	12	19.7	560	4
Group 2.							
Mersey	Protected cruiser, second class.	1887	4,050	12	17.3	325	1
Melampus	do	1892	3,400	8	20	325	1
Tribune	do	1892	3,400	8	20	325	1
Intrepid	do	1892	3,600	8	19.7	325	1
Iphigenia	do	1892	3,600	8	19.7	325	1
Indefatigable	do	1892	3,600	8	19.7	325	1
Pique	do	1892	3,600	8	19.7	325	1
Group 3.							
Niger	Torpedo vessel	1894	810	2	19.3	91	....
Jason	do	1894	810	2	19.2	91	....
Leda	do	1894	810	2	19.2	91	....

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[1] Cruiser classed as battleship for manœuvre purposes.

"D" FLEET.

Rear-Admiral E. C. DRUMMOND, commanding.

First place of assembly, Milford Haven; second place of assembly, the Shannon.

Ships.	Class.	Date of completion.	Displacement.	Guns, main battery.	Maximum speed.	Complement.	Value assigned for manœuvres.
Group 1.					*Knots.*		
WARSPITE (flag)[1]	Armored cruiser	1888	8,400	14	16.7	514	5
AURORA[1]	do	1889	5,600	12	18.1	480	4
GALATEA[1]	do	1888	5,600	12	18.1	484	4
AUSTRALIA[1]	do	1888	5,600	12	18.1	484	4
Group 2.							
SYBILLE	Protected cruiser, second class.	1892	3,400	8	20	325	1
NAIAD	do	1891	3,400	8	20	325	1
APOLLO	do	1892	3,600	8	20	325	1
Group 3.							
HEBE	Torpedo vessel	1894	810	2	19.2	91	....
JASEUR[2]	do	1894	810	2	19.2	91	....
SALAMANDER	do	1891	735	2	20	93	....

[1] Cruisers classed as battleships for manœuvre purposes.

[2] Replaced by DRYAD, torpedo vessel; completed, 1894; displacement, 1,070 tons; main battery, 2 guns; speed, 18 to 19 knots; complement, 91 men.

TORPEDO-BOAT FLOTILLA.

First place of assembly, Falmouth; second place of assembly, respective stations.

HOLYHEAD.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
Depot ship.					*Knots.*		
CURLEW	Gun vessel	1886	950	....	14.5	103	....
Torpedo boats.							
No. 50	2	1886	60	1	17	15	....
No. 59	2	1886	60	1	17	15	....
No. 60 (divisional)	2	1887	60	1	17	15	....

WATERFORD.

Depot ship.							
TRAVELLER	Special service	1884	700	....	....	50	....
Torpedo boats.							
No. 26[3]	1	1886	75	4	21	15	....
No. 27	1	1886	75	4	21	15	....
No. 93 (divisional)	1	1893	130	3	23.5	18	....

[3] Replaced by No. 78, torpedo boat, first class; completed, 1894; displacement, 75 tons; number of tubes, 5; speed, 19 to 20 knots; complement, 15 men.

TORPEDO-BOAT FLOTILLA—Continued.

KINGSTOWN.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
Depot ship.							
MAGNET	Special service	1883	430			43	
Torpedo boats.							
No. 66	1	1886	75	5	19-20	15	
No. 77	1	1886	75	5	19-20	15	
No. 79 (divisional)	1	1886	75	1	22-24	15	

MILFORD HAVEN.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
Depot ship.							
BULLFROG	Gun vessel	1882	435		9.8	60	
Torpedo boats.							
No. 64	1	1886	75	5	19-20	16	
No. 65	1	1886	75	5	19-20	15	
No. 67 (divisional)	1	1886	75	5	19-20	15	

QUEENSTOWN.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
Depot ship.							
BASILISK	Gun vessel	1890	1,170		14.7	131	
Torpedo boats.							
No. 81 (divisional)	1	1885	135	3	20.8	23	
No. 83	1	1889	85	3	23	19	
No. 84	1	1889	85	3	23	19	

PIEL.

Ships.	Class.	Date of completion.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.	Value assigned for manœuvres.
Depot ship.							
TRENT	Gun vessel	1877	363			47	
Torpedo boats.							
No. 72 (divisional)	1	1886	75	5	19-20	15	
No. 73	1	1886	75	5	19-20	15	
No. 74	1	1886	75	5	19-20	15	

July 18 the mobilization took place. From Portsmouth the torpedo boats were the first to get away. After swinging for compass correction, they proceeded to Spithead. The *Seagull*, torpedo vessel, got away about noon, followed shortly after 1 o'clock by the *Rattlesnake*, torpedo vessel. The cruiser *Latona*, the first of the larger vessels, left about 4 o'clock, the last leaving before 8 o'clock. All had completed an hour's full-speed steam trial during the night of the 18th. At Chatham the ships of the Medway Fleet Reserve were in a more advanced state. Most of them left on hoisting their pennants in the order prescribed by the commander in chief. The BARFLEUR, battleship, left on the 19th. At Sheerness the *Onyx*, torpedo vessel, was compelled to put back before beginning her trial, owing to a serious leak in one of her boilers, found upon examination to be due to a defect in one of the plates. Torpedo boat **No. 26** had her propeller injured and had to be towed into harbor. **No. 26** did not take part in the subsequent manœuvres, but was replaced by **No. 78.**

At Devenport all ships to take part in the manœuvres were commissioned at 9 a. m., the commander in chief fixing the time for ships to leave in order to avoid confusion. At noon the *Devastation*, port-guard ship, left for Portland, the gun vessel CURLEW for Falmouth, and the torpedo vessel JASON for Torbay, where she arrived the same day. The PIQUE, cruiser, broke down, owing to defective cylinder packing, and was repaired at Plymouth. No mishaps occurred during the steam and torpedo trials of the torpedo boats.

July 19 the new torpedo vessel JASEUR returned to Sheerness disabled, the eccentric of starboard H. P. engine broken; she was replaced in the manœuvres by the DRYAD, torpedo vessel. This vessel fitting out at Chatham, had not yet been placed in the steam reserve. Orders were issued in the evening of July 20 to commission her, and she left Chatham on the 21st at 2 p. m. and Sheerness for her station on the 22d at 7.30 a. m.

The *Empress of India*, battleship, with the *Repulse*, battleship, and *Barrosa*, cruiser, in company, anchored about 5 p. m., July 19, in Bantry Bay.

The *Antelope*, torpedo vessel, returned to Plymouth July 20 for repairs to her port air pump; she left next day.

July 22 the "*A*" fleet was at Portland, its first place of assembly. At this time the "*B*" fleet was short the cruisers *Thesus*, *Medea*, *Medusa*, and the torpedo vessel *Onyx;* the last named had put back to Sheerness to land a man injured by the machinery. She rejoined July 23 while the fleet was cruising. The others joined on July 22.

July 21 the "C" fleet was assembled at Torbay.

July 22 the "D" fleet was at Milford Haven, except the GALATEA, armored cruiser, reported to have broken her eccentric shaft. She repaired at Portsmouth and left to join the "D" fleet July 25.

PRELIMINARY EXERCISES.

July 23 the four fleets put to sea for a week's preliminary cruise. The day before the *Rupert*, coast-defense vessel, with torpedo boats *Nos. 45*, *52*, *53*, *80*, *85*, and *87*, left Portland for Belfast.

During the preliminary cruise the fleets were exercised at fleet tactics, general quarters, collision drill, fire quarters, etc. During thick weather fog buoys were tried. They consisted of 18 gallon casks painted red with two broad white stripes and towed 150 fathoms astern by a grass hawser. The ship next astern kept her bow near the buoy. It was found the hawsers were too heavy and sank the buoys too deep.

The "C" fleet lost two torpedoes during exercise while at anchor July 28 at Milford Haven. The one lost from the BARFLEUR, battleship, was soon recovered, but divers sent from various ships failed to find the one from the BENBOW, battleship. It was afterwards picked up, however, by a coaster and returned. A torpedo fired from a submerged tube in the MERSEY, protected cruiser, stuck fast and was dislodged with much difficulty by divers.

After reaching their stations the torpedo boats had frequent exercise at evolutions, simulated attacks, and torpedo practice.

The "*A*" fleet anchored at Falmouth July 29 and 30. The "*B*" fleet anchored in Bantry Bay July 29, having sent in the light cruisers and torpedo vessels the 28th to coal and to rest their crews. The "C" fleet was at Queenstown July 30. The "D" fleet was in the Shannon the same day.

Great improvement was shown as the result of the preliminary cruise in all drills, exercises, and evolutions, officers and men "shaking down" rapidly. The various torpedo boats and depot ships reached their respective stations at the proper times. Great activity was shown coaling and preparing for the second part of the program; by the morning of August 2 all the fleets had reported ready.

The following was the distribution of force by points: The *Red* force, Vice-Admiral Fitz Roy, with the "*A*" fleet, 32 points, at Falmouth; Rear-Admiral Dale, with the "*B*" fleet, 32 points, at Berehaven. Six torpedo boats and the *Rupert* at Belfast, no weight of points assigned. Total, 64 points.

The BLUE force, Rear-Admiral Seymour, with the "C" fleet, 38 points, at Queenstown; Rear-Admiral Drummond, with the "D" fleet, 20 points, in the Shannon. Three torpedo boats and a vessel to act as depot ship at each of the following-named ports: Milford Haven, Holyhead, and Piel, on the English coast; Kingstown, Waterford, and Queenstown, on the Irish coast, no weight of points assigned. Total, 58 points.

It will be seen that the *Red* force was slightly superior, although the preponderance of BLUE torpedo boats went far toward counteracting this. The BLUE "C" fleet was stronger than the *Red* "*A*" fleet, while the *Red* "*B*" fleet was stronger than the BLUE "D" fleet. If "C" could force an engagement with "*A*" before "*A*" and "*B*" effected junction, "C" probably would gain a decisive victory, as an excess of points present in action equal to one-ninth of the adversary's was required under the rules.

Experience, however, has shown the great difficulty of forcing an engagement at short notice. The chances seemed good for a junction of the *Red* forces. Nothing was to be done by anyone engaged in the manœuvres that would not be permissible, or likely to be practicable in time of war. No ship was to approach within 8 cables of an enemy's ship. Ships or torpedo boats entering neutral waters, or communicating in any way with the shore in neutral territory, were to be out of action for twenty-four hours. An enemy's ship coming within 6,000 yards of the entrance to a fortified port was to be out of action for twenty-four hours.

As already stated, the "*B*" fleet was superior to the "D" fleet, but Queenstown and the Shannon are nearer to each other, by the only route open, than Falmouth and Berehaven; hence speed for *Red* was an important consideration. While either fleet could increase its speed by dropping its slowest vessels, the difference was largely in favor of the *Red* side. "*A*" and "*B*," by dropping the *Dévastation* and *Conqueror*, became 17-knot fleets by the loss of 8 points, while C and D would be compelled to drop four battleships, or 17 points, to exceed 14 knots.

The following considerations are suggested: First, strength reckoned in points; secondly, speed, which can be increased only by the loss of strength in points; thirdly, an unknown factor, the relative geographical positions of the starting points; and, fourthly, the value of the torpedo vessels and boats with their effect upon the remaining strength of the opposing fleets when brought into action.

Press comments stated:

> It is open to anyone to suppose Falmouth is intended to stand for Malta, Queenstown for London, Belfast for Gibraltar, and Berehaven and the Shannon for Portland and Brest respectively. That there is at least some resemblance is unquestionable, and this may increase the interest in the forthcoming manœuvres.

By holding a map of the area of manœuvres to the light, with the back toward the observer and the top to the left, the resemblance to the coasts of Great Britain, France, and the Mediterranean is very marked; the *Red* territory at Berehaven representing the Plymouth and Portsmouth district; the Shannon, Brest or Cherbourg, with Belfast as Gibraltar, at the entrance to the Mediterranean, and Plymouth representing Malta, beyond the two strips of French Mediterranean territory.

MANŒUVRES.

August 2 the fleets left their second places of assembly for their several rendezvous in obedience to telegraphic orders. Hostilities were to begin at 9 o'clock the following evening. The "*A*" fleet was sent to latitude 48° 30′ N., longitude 6° 30′ W.; the "*B*" fleet to latitude 51° 25′ N., longitude 12° 30 W.; the "C" fleet to latitude 50° N., longitude 9° W., and the "D" fleet to latitude 52° 30′ N., longitude 12° 30′ W. The *Red* rendezvous were not known to the BLUE side and vice versa. At 11 a. m., August 3, the time hostilities were to begin was made known to torpedo boat and signal stations and to telegraph stations within the area of the manœuvres.

Red side.

"A" fleet.—The plan of the *Red* side was based upon the supposition that the BLUE "C" fleet would occupy the southern entrance of the Irish Channel. This fleet was then to be drawn off from the eastern side of the channel in pursuit of the fast cruisers to the westward, while the fighting part of *Red "A"* would slip through and effect junction with *Red "B."* Once past "C" the success of the *Red* side was certain, as "D" would be crushed between the two superior fleets, after which an overwhelming force could destroy "C," or drive it to the shelter of a fortified port.

The "*A*" fleet left its rendezvous when hostilities began August 3, and steamed at 10 knots to Labadie Bank, regulating speed so as to arrive there about noon. It was ordered that no firing at torpedo boats was to take place, but they were to be driven off by the torpedo vessels, and no lights were to be shown except to avoid collision.

At Labadie Bank the cruisers *Brilliant*, *Rainbow*, *Sappho*, *Scylla*, *Terpsichore*, and *Thetis* and the torpedo vessels *Antelope*, *Rattlesnake*, *Circe*, and *Renard* were detached about noon, August 4, and ordered to steam through the middle of the channel at 17 knots, and to join the "*B*" fleet at a preconcerted rendezvous off Rathlin Island, north of Ireland, the object being to draw off the enemy's main fleet in pursuit under the supposition that it was the "*A*" fleet, but to go at too great a speed to fear injury from torpedo boats. They were out of sight by 6 p. m., when the rest of the fleet at 11 knots shaped a course for the Irish coast. Later, speed was increased to 15 knots. The *Dévastation*, unable to keep up, was left to follow as best she might. The first-class torpedo boats *Havock* and *Hornet* took station ahead, while the torpedo vessels *Speedy*, *Speedwell*, and *Seagull* covered the rear. Although rated at 20 knots, the torpedo vessels in the rough sea fell astern. At 5 a. m., August 5, the fleet passed Queenstown, and at 8 a. m. was off Carlingford Bay, when the light squadron, with the *Latona* in company, rejoined. The BLUE fleet was sighted at 9.55 a. m.

"B" fleet.—Upon leaving the rendezvous at 10 knots speed the "*B*" fleet shaped course for the northwest coast of Ireland. The cruisers *Latona* and *Andromache* were sent ahead at full speed to get news of the BLUE "C" and "D" fleets and to communicate with the Whitehead signal station before dark, August 4. Speed was increased to 11½ knots, the limit allowed by the *Conqueror*, and course shaped for Malin Head. The cruisers *Medea* and *Medusa* were sent ahead to get news of the "D" fleet, but with orders not to pass Malin Head. At 9.10 p. m., August 4, the cruiser *Pearl* was sent to meet the *Andromache*, which vessel at 10.10 p. m. reported having sighted the "D" fleet at 1 p. m. 12 miles north of Aran Island, that she and the *Latona* had been chased back 5 miles, but had then followed the hostile fleet again, and that the "D" fleet had passed Rathlin Island at 8 p. m. The *Medea*

had chased the SALAMANDER and claimed to have put her out of action off Deelin Head. The *Latona* failed to communicate with Belfast through Whitehead signal station.

When near the Maidens at 5.10 a. m., August 5, the combined BLUE fleets of 22 vessels were sighted on the port bow and the "*B*" fleet steamed full speed for Belfast. At 5.48 a. m., when about midway between Garron Point and the Maidens, the engagement began at 4,000 yards range, and was continued until 6.40 a. m., when the "*B*" fleet, except the *Barrosa*, had passed within the limits of Belfast Lough. Here the "*B*" fleet was secure against attack, but did not anchor awaiting developments. Before entering Belfast the *Latona* was sent to the southward to warn the "*A*" fleet of what had taken place. She was chased by the battleship BARFLEUR, but escaped by her superior speed. In making for Belfast the "*B*" fleet passed within 6 cables of the Maidens, violating the rules and entailing the penalty of being put out of action for twenty-four hours.

BLUE SIDE.

"C" FLEET.—The plan of the BLUE side was for the "C" fleet to unite with the "D" fleet: first, in order to preserve the latter from defeat by either "*A*" or "*B*"; second, that being united, the BLUE side might be so superior to either "*A*" or "*B*" as to be certain of overpowering them if met alone, with a possibility of conquering them if united; or, at least, of avoiding defeat if the *Red* side had been weakened by the operations of the BLUE torpedo boats, by the detachment of ships, or by other causes. It was the main object of the Admiral to place his whole force between the two fleets of the enemy. The narrowest channel being easiest to guard, the North Channel was selected.

As regards the BLUE torpedo boats, the Admiral decided to move those at Queenstown farther north at the beginning of hostilities, and to use those at Waterford, Kingstown, Milford Haven, and Holyhead primarily against the "*A*" fleet if trying to push north; secondarily, against any of the enemy passing through the Irish Channel. The boats from Piel were to operate toward Belfast, with the cruiser INTREPID acting as scout and escort. If the state of the weather prevented this, the boats were to seek shelter under the northeast coast of the Isle of Man and to look out for *Red* vessels trying to pass. The cruiser IPHIGENIA, with the torpedo vessels LEDA and JASON, were also detached to support the torpedo boats.

At 9 p. m., August 3, the "C" fleet left its rendezvous at 10 knots speed (that of the INFLEXIBLE), and steered to the northward by a route prearranged with the "D" fleet, so that they should not miss each other. When off Carnsore Point, at noon of August 4, the torpedo vessel NIGER was sent to communicate with the signal station there. At this time BLUE "C" was 12 hours ahead of *Red* "*A*." The NIGER, returning, brought news that three cruisers had passed Blacksod Bay at 8 a. m. As these ships had not answered the challenge, it was concluded they belonged to the "*B*" fleet. The night of August 4 two of their own torpedo boats, **Nos. 81** and **83**, were put out of action by the "C" fleet through mistakes on both sides. The PIQUE, cruiser, was successfully torpedoed by a *Red* torpedo boat, near Belfast, and put out of action. The cruisers ST. GEORGE and INDEFATIGABLE were especially useful as scouts, the great speed of the former enabling her to acquire information and to communicate it promptly. A ship thrown out as repeating ship, nearly to the limit of signal distance, conveyed information to the fleet. While scouting, the ST. GEORGE made 19 knots, and it is thought her junction with the BLUE "D" fleet rendered the *Red* torpedo-boat attack a total failure.

"D" FLEET.—The "D" fleet left its rendezvous at the appointed time and made for the North Channel at 14 knots. August 4, at 12.30 p. m., two cruisers were sighted off the Bloody Foreland, which were reported by the lookout ships to be enemies. These cruisers remained out of range, but kept the fleet in sight. The night of the 4th, at 10.20 p. m., when near the Maidens, the fleet was attacked by three torpedo boats, which, it was claimed, were all under a heavy fire in the rays of the search lights. A second attack not long after was successfully resisted and the boats were driven off. One boat discharged a torpedo at the GALATEA, but missed her. The GALATEA claimed to have put her out of action. The cruisers APOLLO, NAIAD, SYBILLE, and the torpedo vessel HEBE were then sent out to endeavor to catch torpedo boats returning to Belfast and to scout toward the "*B*" fleet. The AURORA also was sent on scouting duty and lost touch with the "D" fleet. Later she proceeded to the rendezvous off the Calf of Man and remained six hours as previously stipulated. While there the "*A*" fleet passed without discovering her. She started back at 9 a. m., August 5 and was able to rejoin her own fleet and take part in the action with the "*A*" fleet.

At 12.40 a. m., August 5, the "C" fleet was sighted ahead. At 2 a. m., *Red* torpedo boats again attacked; one boat discharged a torpedo across the ALEXANDRA'S bows, a second missed her stern by only about 5 yards and a third, although discharging her torpedo from off the starboard beam, missed her entirely. The attack seemed to be directed mainly against the ALEXANDRA.

THE BLUE FLEET.

"C" and "D" met about 2.30 a. m., August 5, 5 miles to the northward of the Calf of Man and steamed for the North Channel together. At 5 a. m. the "*B*" fleet was sighted and measures were taken to cut it off from Belfast. The engagement took place as already described. Later, when the "*B*" fleet was seen coming out of Belfast Lough, Rear-Admiral Seymour commanding, the BLUE side sent a flag of truce to

Rear-Admiral Dale, commanding the "*B*" fleet, claiming the fleet under several violations of the rules. Rear-Admiral Dale also claimed the COLOSSUS and EDINBURGH for having approached within the 6,000-yard zone of the defenses of Belfast while trying to cut off the *Conqueror.*

The BLUE fleet now stood to the southward to intercept the "*A*" fleet, which was sighted at 10.10 a. m. The "*A*" fleet apparently was making for Belfast when first made out. The fleets approached on nearly opposite courses, the "*A*" fleet being nearer the Irish coast. When the "*A*" fleet was abreast of the BLUE fleet the "*B*" fleet was in sight coming from Belfast. The "*A*" fleet changed course simultaneously 16 points and stood parallel with the BLUE fleet. At 10.20 a. m., when the action began, the opposing fleets were about 15 miles south of Belfast. The ALEXANDRA fired the first gun at 10.20 a. m., and at 10.27 the action was general. At the beginning of the action the *Dévastation* was absent from the "*A*" fleet, but she rejoined at 10.52 a. m. The BLUE fleet was short the IPHIGENIA, INDEFATIGABLE, and AURORA. Counting the *Dévastation* as present, the preponderance of the BLUE side amounted to 20 points, or 52 points to 32. The AURORA rejoined the BLUE side during the action, raising the total to 56 points. At 10.48 a. m. the *Empress of India* came within range and opened fire. This may be taken as the time of the junction of the *Red* fleets. At 12.30 p. m. the engagement terminated, having lasted the prescribed two hours, and each side claimed a complete victory. By mutual agreement hostilities were suspended, the *Red* fleets put into Belfast, the BLUE "C" fleet went to Kingstown and the BLUE "D" to Holyhead to await the decision of the umpires.

Their decision, given August 7, was as follows: Claim of "C" and "D" fleets for "*B*" *Red* fleet on morning of 5th allowed; claim of "*B*" fleet for EDINBURGH and COLOSSUS allowed; claim of *Alarm*, *Onyx*, *Sheldrake*, *Gossamer* against AUSTRALIA disallowed; claim of "C" and "D" fleets against "*A*" *Red* fleet allowed. Thus the BLUE side gained a complete victory.

FORMATIONS AND EVOLUTIONS.

The usual formation of the "*A*" fleet during tactical exercises was with the 6 large vessels in double columns from 8 to 10 cables apart; distance between ships, 4 cables; astern of these were 4 of the smaller vessels, 2 in each column; outside these were 2 more columns of light vessels parallel to the others and distant about 4 cables.

The "*B*" fleet was divided into 2 divisions; the first division composed of group 1; the second division, all the other vessels distributed as scouts, ahead, astern, and on either flank. The first division was in column of vessels. The formation of the BLUE fleets while cruising was similar to that of *Red* "*A*."

The "*A*" fleet left its rendezvous in column of sections with the *Royal Sovereign* and *Resolution* leading. The cruisers started from

Labadie Bank in column of vessels. Column of sections was maintained until after sighting the BLUE fleet, when it was altered to column of vessels, with the cruisers and light vessels on the disengaged side. After the "*B*" fleet was made out coming from Belfast, course was changed simultaneously 16 points, bringing the hostile fleets on parallel courses. The *Blenheim* leading, then the *Bonaventure*, *Resolution*, *Endymion*, *Royal Sovereign*, and *Dévastation*, in the order named.

The "*B*" fleet left its rendezvous in column of vessels, the *Empress of India* leading. On her starboard beam, at 6 cables' distance, were the *Latona* and *Andromache;* similarly disposed on the port beam were the *Medea* and *Medusa;* on the quarter of the rear vessel, the *Astræa*, were the *Pearl* and *Barrosa*. The *Alarm*, *Onyx*, *Gossamer*, and *Sheldrake* were scouts and lookouts. At 8 a. m., August 4, the fleet formed in double column, the flagship leading the starboard column. At night the light squadron formed astern of the battleships. When the BLUE fleet approached, the formation was changed to column of vessels, the *Empress of India* leading, then the *Theseus*, *Repulse*, *Gibraltar*, *Conqueror*, and *Astræa*, in the order named, though later the *Conqueror*, being unable to keep up, fell astern. The cruisers took station on the disengaged side.

The "C" fleet left the rendezvous in columns of sections, the starboard column headed by the ALEXANDRA and the port by the MERSEY. On the starboard flank were the ST. GEORGE and three of the cruisers; two were on the port flank. The torpedo vessels, as lookouts, were one on the ALEXANDRA'S starboard bow and two off the MERSEY'S port quarter.

When the "*B*" fleet was sighted to port under the land, the BARFLEUR, COLOSSUS, and EDINBURGH steered in to head them off from Belfast, while the others changed course simultaneously 16 points. In the running fight that followed, regular formation was broken in the effort to cut off the enemy.

The "D" fleet left the rendezvous in column of vessels, with the WARSPITE leading, followed by the AURORA, AUSTRALIA, and GALATEA. The APOLLO, SYBILLE, and NAIAD were off the starboard beam, the HEBE and DRYAD off the port beam. Approaching the North Channel the SYBILLE, and NAIAD were sent 3 miles ahead, and the other ships closed up, with the HEBE and APOLLO on the port flank. At this time the DRYAD had fallen astern and the AUSTRALIA was sent to guard her. They rejoined after daylight. With no lights showing, the fleet ran through the North Channel without molestation.

When the "C" and "D" fleets united there were 13 out of 16 of the "C" fleet and 7 out of the 10 of the "D" fleet—all the heavy ships except the AURORA, which joined during the second battle, and all the cruisers except the IPHIGENIA and INDEFATIGABLE, giving a total of 52 points.

"C" and "D" were in column of vessels, except the BARFLEUR, COLOSSUS, and EDINBURGH, when "*B*" was attacked. During the action with "*A*" the formation at first was 4 divisions—divisions in line, changed later to divisions in echelon. In this formation the BLUE fleets were in much closer order than *Red* "*A*," though the first and second divisions were widely separated. In the first division were the WARSPITE, GALATEA, and AUSTRALIA; in the second division, the ALEXANDRA, INFLEXIBLE, and BENBOW; in the third division, the BARFLEUR, EDINBURGH, and COLOSSUS; in the fourth division, the ST. GEORGE and the cruisers.

TORPEDO BOATS.

"No ship was put out of action by a torpedo boat. The lightness of the nights seems to have had a twofold effect. *No. 80* (*Red*) in evading a torpedo vessel at first missed the BLUE fleet, but managed to keep up with it and got within range of the rear ship, which was not attacked, because she was supposed to belong to group 3, a class exempted from torpedo attack by the rules. The light apparently was not sufficient to permit the real character of the ship to be ascertained. On the other hand, it is reported that the nights were never really dark enough to afford concealment to the torpedo boats.

"The torpedo lieutenant in command of *No. 80* makes the interesting observation that owing to the speed of the hostile fleet the boats were unable to regain their position for attack when once it had been lost. From this it seems permissible to infer that high speed will be of itself no unimportant protection to ships traversing at night narrow waters infested by torpedo boats. The torpedo boat operations were upon a too restricted scale to supply much valuable instruction, but as far as they went they tend to confirm the view that the most effective employment of the torpedo boat in war will be limited to sending her to attack an enemy's ship in a known position within the boat's range of action, and that the whereabouts of the enemy must be first ascertained and be communicated to the commander of the boat. The necessity of combining with torpedo boats vessels of other and larger classes to scout and discover the enemy, where exact information as to his position can not be obtained by other means, seems to be established, and, if so, it carries with it the obligation to consider a mere flotilla of torpedo boats by themselves as a belligerent factor of distinctly imperfect efficiency." *

While at anchor in Belfast about 2 a. m., August 6, an alarm raised by a patrol boat brought on heavy firing and the liberal use of search lights by the *Red* fleet.

A pigeon obtained from Dublin by the officers of the *Latona* carried a message ashore for a correspondent when the ship was 60 miles at sea. Commander Login, of this vessel, shortly after her mobilization sent several pigeons to his private aviary at Whale Island, where they all arrived in safety.

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* From the official report.

August 7, at 6 p. m., by Admiralty order, the manœuvre operations were brought to a close.

After target practice, the "*A*" fleet went to Spithead, the "*B*" fleet to Torbay, the "C" fleet to Portland, and the "D" fleet to Plymouth Sound. After inspection the ships dispersed.

COALING.

Twenty vessels of tonnage varying from 450 to 650 tons were chartered by the Admiralty to serve as colliers, at the rate of 9 shillings ($2.19) per ton. Twelve Temperly's transporters, delivered at Cardiff and issued in pairs to six of the colliers, worked well in putting the coal on board, but there was considerable delay in stowing. It was noted that the battleships coaled faster than the cruisers. The *Empress of India*, battleship, made the best record in the fleets by coaling at the rate of 50 tons per hour. The *Colossus*, battleship, coaled at the average rate of 30 tons per hour. The *Endymion*, protected cruiser, at an average rate of about 33 tons per hour, took in 200 tons at night. The *Blenheim's* (armored cruiser) average rate for four hours was 37½ tons per hour, while on board the *Theseus*, protected cruiser, with a bunker capacity of 1,200 tons, it was found impossible to stow at a better rate than 19 tons per hour. These figures plainly indicate that rapid stowing is the main factor in the problem of rapid coaling, which will become a vital one in time of war, and seem to point to the necessity for an expert coaling force organized in connection with the colliers; for it is to be expected that the crews of ships coming into port to refill their bunkers will be too much exhausted by their work at sea to undertake advantageously the still more arduous work of coaling. The experiences of the manœuvres emphasize the recognized necessity for simplifying the complicated system of impracticable shapes, sizes, and locations of coal bunkers that has come into vogue as the natural sequence of a too strict adherence to the idea of compartment subdivision in construction.

SIGNALS.

The flag hoists worked fairly well for day signaling, but it was thought that some other system would have to be devised for use in actual war, since under the present conditions the signal men are too much exposed and the signal halliards too liable to be shot away early in an action. In night work the multiple fiber lamp was much liked for masthead work. The Scott shutter lamp did not function well and was condemned for use in the fleet.

BILGE KEELS.

The utility of bilge keels in diminishing rolling was shown by the behavior of the three sister ships, *Repulse* being with them and *Empress of India* and *Resolution* without them. The former ship rolled but very slightly even when green seas were coming aboard, while her two sisters showed as much as 30 degrees of roll. Bilge keels have since been fitted to all the battleships of this type.

TARGET PRACTICE.

Moving practice with great and R. F. guns was held, and the use of the Barr and Stroude range finders found favor. One of the results of the target practice held after the manœuvres was the demonstration of the power and usefulness of the Maxim gun. Great-gun and rapid-fire target practice was conducted while under way by towing a target astern of each ship while the fleet was in double column, in echelon of columns. The targets used were triangular in shape, presenting three faces, each 12 feet long by 5 feet high. Each ship fired at the target abeam, towed by the ship next ahead of her in the opposite column. Fault was found with hydraulic turret-training gear; on the other hand, electrical training gear is regarded with great favor.

Mobilization under war conditions would not be conducted in the same manner as that preceding the manœuvres. It was known officially and published in the press June 18 that the mobilization would take place July 18. Everything possible was done during the month to advance the condition of ships not already in commission. As a consequence, the rapidity with which ships were commissioned and left the navy-yards represented in many cases a month's work.

CASUALTIES.

ALEXANDRA: A gun broke adrift during the heavy weather on August 3. A man was killed by being struck on the head by the training handle when attempting to apply the compressor.

AURORA: Machinery broke down. Repairs were made at sea.

BENBOW: A slight defect in the engines was found on the night of August 2. Repairs were made at sea.

Empress of India: An accident to the steering gear delayed the ship for two hours during the first week of the manœuvres.

GALATEA: Eccentric of port engine broke. Repairs were made at Portsmouth.

Resolution: A boat was lost during the heavy weather on August 3.

Astræa: The capstan engine was disabled and replaced by a similar one taken from the *Hermione.*

Gossamer: The rods of the main feed pump broke. New rods were sent from Keyham to her at Berehaven.

INTREPID: Air pumps worked so badly that the ship had to haul out of line. Repairs were made by ship's force.

Latona: Steering gear temporarily disabled and rudder injured.

Medea: Steering gear temporarily disabled.

Pearl: Steering gear broke down on trial when the ship was commissioned. Repairs made by ship's force.

PIQUE: Cylinder packing was found to be defective. Repairs made at Plymouth. Defective distiller was replaced by one from *Retribution.*

Rainbow: Minor defects in machinery forced ship to haul out of line. She soon rejoined the fleet.

ST. GEORGE: Engine-room indicator broke down.

Antelope: Port air pump was disabled. Repairs were made at Plymouth. Main feed pump gave out just before the second battle.

DRYAD: Steam pipe was defective. Repairs made at Pembroke.

JASEUR: Starboard engine was disabled. Returned to Sheerness.

JASON: Main feed pipe of one of her boilers burst. Repairs made at Plymouth.

Onyx: Leak was developed in starboard forward boiler on trial when commissioned. Ship returned to Sheerness.

Rattlesnake: Some slight repairs had to be made. Ship was sent to port for this purpose.

SALAMANDER: Machinery broke down while ship was steaming to effect a junction with "C" fleet.

Spider: A boat was lost during the heavy weather on August 3. Afterwards the feed pipes gave out, and the ship was forced to leave the fleet.

Havock: A defective stay in one of the boilers necessitated repairs.

Hornet: Condensers leaked. While chasing during the second stage of the manœuvres the engines were disabled, owing to the giving way of a bolt in the crosshead. Before the engines could be stopped a cylinder cover was cracked, two piston rods broken, and a large hole knocked in the condenser.

Some of the defects developed in the *Havock* and *Hornet* are reported to have been due to the slow speed (5 knots) at which they were compelled to steam in order to keep their stations in a rough sea. These vessels were very uneasy and severely tried their engines.

26 (torpedo boat): Propeller was damaged by striking an obstruction in Totlands Bay. Boat returned to Portsmouth.

45 (torpedo boat): Plates were forced in and seams opened by a blow from an exercise torpedo discharged by *53* (torpedo boat) during practice. After a collision mat was placed over the hole at Carrickfergus she made a full-speed run to Belfast for repairs, and just succeeded in making port with her fires out, since her pump service could not keep the water below the grate bars. At a later stage of the manœuvres an accident happened to one of her cylinders.

67 (torpedo boat): Steering gear was defective and gave trouble during the manœuvres. Bow plates were sprung by the boat's ramming and sinking a water tank vessel at Pembroke. This last injury was not at first apparent, but developed during the fast run to Plymouth.

71 (torpedo boat): Leak was developed and boat returned to Portsmouth.

72 (torpedo boat): Feed pumps choked. Boat was towed to Plymouth by **73** (torpedo boat).

74 (torpedo boat): A small steam pipe burst and the rudder was injured. Repaired by crew.

79 (torpedo boat): Cylinders were found to be out of order. Boat was detained at Falmouth.

83 (torpedo boat): Shaft was reported as broken. Boat was towed into Queenstown.

87 (torpedo boat): Machinery slightly defective. Repairs made by crew.

93 (torpedo boat): Machinery broke down twice during the manœuvres. Repairs were made at Falmouth. After the first repairing, which was followed by a satisfactory trial, the crosshead bolt of her starboard engine broke and she returned to Falmouth, at a speed of 14 knots, under her port engine. The starboard engine was repaired and the bow, which had developed structural weakness, was strengthened, after which no further trouble was experienced.

A number of ships were temporarily disabled by defects in their steering gear.

COMMENTS.

The mobilization was carried out without confusion. Officers and men took up their duties punctually, and the ships got away from the navy-yards with promptness. The experience gained, not only by those taking part in the mobilization of such a large force, but also by those directing it, is particularly valuable, enabling them to discover and correct defects in a system that can approach perfection only through a series of such tests. The composition of the fleets, many of the ships being commissioned only for the manœuvres, rendered necessary a preliminary cruise. This cruise is valuable to prepare the personnel for the strategical program by enabling commanding officers to gain experience manœuvring their vessels during the fleet evolutions; officers and men to "shake down" into their duties, and thus bring about that unity and cohesion which make men of war of ships and fleets of their aggregation.

The task set the *Red* fleets was a difficult one. Although their speed was superior to that of the BLUE fleets, the latter were operating on interior lines and their junction could be effected more quickly than that of the *Red* fleets. In the neighborhood of Belfast alone did the BLUE fleets run danger of torpedo-boat attack, while the "*A*" fleet, traversing the Irish Channel, was exposed to the attacks of a number of torpedo-boat flotillas. The time lost by Admiral Fitzroy with the "*A*" fleet was lost with a purpose, in order to develop the strategy of Admiral Seymour of the "C" fleet. Admiral Fitzroy based his movements upon the supposition that the BLUE fleets would attempt to oppose his advance at the southern entrance to the British Channel; "C" to hold him until the arrival of "D" would insure his defeat, not to mention the aid to be derived from the torpedo boats. The "*A*" fleet, having a weight assigned of but 32 points, was liable to defeat by the "C" fleet alone, with an assigned weight of 38 points; but the "C" fleet was not strong enough to capture the "*A*" fleet. The "*A*" fleet, by its superior speed, had a much better chance to avoid decisive action with the "C" fleet than would at first sight appear.

Meanwhile Admiral Seymour, rightly judging that his best chance of ultimate success lay in defending the narrowest channel, and that, too, nearer the "D" fleet, made all speed to effect junction and at the same time to keep ahead of the "*A*" fleet. Although inferior in speed to the "*B*" fleet, the "D" fleet made such good use of its time as to effect junction with the "C" fleet before either of the *Red* fleets caught up. The BLUE fleets had passed Belfast and were within less than 20 miles of their chosen line when the "*B*" fleet was made out. This was the turning point in the manœuvres. It is impossible to say what would have been the result if Admiral Dale, commanding the "*B*" fleet, had not ignored rule 39 governing the manœuvres, which forbade approaching within 6 cables of neutral territory, or if he had availed himself of his superior speed to steam northward into the Atlantic.

In real warfare it would have been impossible for the "*B*" fleet to reach the shelter of Belfast, opposed as it was by a force nearly double in weight of points (32 to 52). Besides, the BLUE fleets would have cut off the "*B*" fleet from Belfast by interposing between it and that harbor, as in war no requirements of distances or rules would have restrained an overwhelming force from falling directly upon its adversary. That the BLUE fleets would have received injury, perhaps extending to the loss of several ships, seems certain, but the "*B*" fleet would have been either annihilated or so much injured as to be incapable of giving the "*A*" fleet any assistance. The only doubtful point connected with the first engagement is the amount of injury the "*B*" fleet might have inflicted on the BLUE fleets and whether their fighting power would have been reduced below that of the "*A*" fleet.

Much useful information had been expected from the scouting experience to be gained during these manœuvres, but the operations were brought to a close at that stage of the proceedings when scouting might have been of the most value. Every increase of mobility in a fleet will make the duties of scouts more difficult and at the same time more important. Upon discovering that the BLUE fleets had effected junction, which should have been known to him through his scouts before sighting them himself, Admiral Dale, commanding the "*B*" fleet, could have varied the problem to such an extent as to open a wide field for speculation. Of the questions thus raised one of the most important is that of endurance or ability to keep the sea. The "*B*" fleet was faster than the BLUE fleets and it would have been impossible for Admiral Seymour to catch it without so weakening the force holding the North Channel as to expose that force to capture by the "*A*" fleet. Tactical and strategical considerations then, made it necessary for the BLUE admiral to keep his force together.

In order to develop the rôle of the scout it has been suggested that cruisers and fast light vessels also used for scouting be assigned no weight of points and that the rules governing manœuvres be so framed as to make them of no value in action; fleet commanders then will be under no temptation to retain these vessels with them to increase the fighting power of their respective fleets, but will assign them to scouting duty.

The comparatively minor part played by the torpedo boats is a contrast to what they accomplished last year (p. 341, No. XIII). It is true, however, that the nature of the movements threw the BLUE flotillas almost out of the sphere of action, and the time available, only one night, was too limited for any definite conclusions to be reached. In connection with this subject the only point brought out seems to be that "high speed will be of itself no unimportant protection to ships traversing at night narrow waters infested by torpedo boats."

The so-called panic among the *Red* ships at anchor in Belfast Harbor calls for a system of signals whereby there will be no failure to recognize patrol boats and emphasizes the possible danger of friendly ships injuring one another through the indiscriminate use of search lights during a torpedo attack.

THE FRENCH NAVAL MANŒUVRES.

The naval manœuvres were designed to test the operation of the new decree for the defense of the coast of France. As a consequence the operations of the fleets were mainly confined to attacks on the coast. A brief outline of the present system of coast defense is given below. (*See also* p. 95, General Information Series, No. XII). For the purposes of defense the five maritime districts (*arrondissements*) are divided into 19 coast sectors, as follows:

District number.	Sector number.	Headquarters and name of sector.	Under control of— (A = Army, N = Navy).	Boundaries.
First	1	Dunkirk	A.	Belgium to Cape Gris-Nez.
	2	Abbeville	N.	To mouth of the Scie, inclusive.
	3	Havre	N.	To mouth of the Dives.
	4	Cherbourg	N.	To mouth of the Ay, inclusive.
Second	5	St. Malo	N.	To Cape Fréhel.
	6	St. Brieuc	N.	To mouth of the Douron.
	7	Brest	N.	To mouth of the Aven.
Third	8	Lorient	N.	To Grand Mont Point.
	9	St. Nazaire	N.	To Coupelasse Point.
Fourth	10	Les Sables-d'Olonne	N.	To Point Grouin-du-Cou.
	11	Rochefort	N.	To mouth of the Sendre.
	12	Royan	N.	To Arcachon Basin, inclusive.
	13	Bayonne	A.	To Spanish frontier.
Fifth	14	Perpignan	A.	Spanish frontier to mouth of the Aude.
	15	Cette	N.	To Grau-du-Roi, exclusive.
	16	Marseilles	N.	To Sèche d'Alon.
	17	Toulon	N.	To Cape Nègre.
	18	Antibes	A.	To mouth of the Var.
	19	Nice	A.	To the Italian frontier.

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Corsica and Algiers-Tunis each form an independent sector. Sectors marked "A" are commanded by a general or superior officer of the army; those marked "N" by a flag officer (*officier général*) or superior officer of the navy. Commanders of sectors are under the orders of the maritime prefects, who are under the minister of the navy or war. The commander of the Marseilles sector is under the orders of the general commanding the army corps in that region, as far as the defense of that place is concerned. For the rest of his sector, and for the employment of the navy, he is under the maritime prefect of Toulon. The governors of Dunkirk, Bayonne, Perpignan, and Nice command their sectors. Each commander of a sector has for assistant a superior officer of the other service, naval or military, as the case may be. The maritime prefects direct the semaphore service in what relates to naval operations. All orders to the semaphore service and to the sea mobile defense are, if possible, sent through the sector commander; if not so sent, he must be informed.

Under the authority of the sector commander are:

1. The coast brigades and the active units of the customs service. 2. After their mobilization, the forces organized for coast defense under cognizanc of the war department. 3. Marine troops of the sector. 4. Fixed defenses under cognizance of the navy department. 5. Floating defense elements: Coast defense vessels, cruisers, torpedo boats, under the maritime prefect of the district, when a place in the sector where they may be stationed is attacked. Sector commanders are independent of territorial commanders until reenforcements called for by them exceed three battalions, when the general commanding the region will take command of all land operations, under the minister of war. He can take command of all operations, if of sufficient importance, under a special order of the minister of war.

CHANNEL AND ATLANTIC.

The operations began on the night of July 15, 1894; in the north they were divided into three separate parts: 1. The surprise of various points along the coast, the destruction of their defensive works, and attempts at landing. 2. As last year (*see* p. 351, General Information Series, No. XIII), the forcing of the Straits of Dover by a hostile fleet at night. 3. Torpedo-boat attacks upon an enemy's fleet at anchor and underway in defense of a threatened place.

PART I.

The Northern Squadron, under the command of Vice-Admiral Brown de Colstoun, went to sea the evening of July 15. Hostilities were to begin at 12.30 p. m., July 16, and to cease at noon on the 20th.

The following-named vessels composed the Northern Squadron:

Ship.	Class.	Date of launch.	Displacement.	Guns, main battery.	Maximum speed.	Complement.
					Knots.	
Suffren (flag, vice-admiral)	Battleship	1870	7,782	14	14.3	675
Victorieuse (flag, rear-admiral).	Armored cruiser	1875	4,700	13	12.8	376
Requin	Coast-defense vessels	1885	7,200	2	15	332
Furieux	do	1883	6,000	2	13.8	248
Tonnerre	do	1875	5,589	2	14	249
Fulminant	do	1877	5,651	2	14	248
Isly	Protected cruiser, first class.	1891	8,100	10	19	332
Jean-Bart	do	1889	8,000	10	19	332
Epervier	Protected cruiser, third class.	1886	1,240	5	17.3	134
Surcouf	do	1889	1,848	4	19.5	190
				Tubes.		
Lance	Torpedo vessel	1886	395	2	18	63
Salve	do	1886	395	2	18	63
Averne	Torpedo boat, first class.	1894	115	2	25.2	34
Turco	do	1892	119	2	20.5	26
Lancier	do	1892	119	2	25.8	26
Archer	do	1893	120	2	20.5	26
Zouave	do	1892	119	2	21.5	26
Grondeur	do	1892	114	2	24	34
Grenadier	do	1892	119	2	25.5	26

The period of naval manœuvres is utilized to call out a portion of the *réservistes* for their yearly training. They are embarked upon vessels undergoing trials and upon vessels mobilized from the second category of reserves.

The following is a list of the number of *réservistes* and vessels mobilized:

Port.	Réservistes.	Vessels.	Torpedo boats.
Cherbourg	600	Turenne (armored cruiser), Latouche-Tréville (protected cruiser, first class), Flamme (armored gun vessel), Cocyte (armored gun vessel), Phlégeton (armored gun vessel).	First class: Grenadier, Grondeur, Zouave, Dehorter, Nos. 129, 166, 170, 171, 163, 165, 145, 146. Second class: Nos. 60, 70, 72, 81, 90, 106, 107, 111, 114.
Brest	650	Tourville (protected cruiser, first class), Jemmapes (coast-defense vessel).	Second class: Nos. 61, 73, 75, 80, 81, 84, 136, 137, and 5 others.
Lorient	250		8 or 10.
Rochefort	300	Charner (protected cruiser, first class), Chanzy (protected cruiser, first class), d'Iberville (torpedo vessel).	8.
Toulon	550	Acheron (armored gun vessel), Fusee (armored gun vessel), Mitraille (armored gun vessel).	First class: Nos. 173, 178, 180, 181. Second class: Nos. 85, 94, 96, 98, 101, 103.

The *réservistes* of the first four districts began to embark July 9 aboard the mobilized gun vessels and torpedo boats.

To test the system of coast defense as applied to sectors thrown, as it were, upon their own resources, the Havre and Dunkirk sectors were to receive no aid except that furnished by their own mobile defense. Hence, while the attack upon ports or the debarkation of landing parties was rendered easier, absolute conclusions could not be drawn owing to the absence of a defensive squadron, which, in real war, would at least make such attempts rather hazardous.

In the Lorient and Rochefort districts the third-class protected cruiser *Fabert*, after filling her complement with réservistes at Lorient, cruised off the mouths of the Gironde and the Loire during two weeks, where the mobile defense of these two districts tried to break the blockade established by her. No other portions of the coast defense of these districts took part.

At Havre the shore batteries were manned, the garrison was made ready to repel attempts to land, and the Havre fire brigade prepared to extinguish imaginary fires where liable to occur. July 18, at 3 a. m., a cruiser approached Havre, fired a gun, and then a rocket, indicating, under the rules, that the attacking squadron would appear in less than two hours. It was made out at daylight, 7 or 8 miles to the eastward of Cape Hève. The *Phlégéton* and *Cocyte*, armored gun vessels, were under way in the roadstead, and four torpedo boats were sent well to the front. At 5.30 a. m. firing began. The attacking force was divided into two groups—the *Suffren*, battleship, *Victorieuse*, armored cruiser, *Requin*, coast-defense vessel, and *Tonnerre*, coast-defense vessel, attacked the forts between the jetty and Hève; the coast-defense vessels *Fulminant* and *Furieux* the battery in front of Villerville. The protected cruisers *Surcouf*, *Jean-Bart*, and *Epervier* remained out of range as outposts, taking no part in the attack. The vessels steamed in ellipses in front of the batteries. The four torpedo boats that remained outside were driven by a counter attack to take shelter within the range of machine guns and infantry.

The principal object of the attack upon Villerville was to effect a landing and to take in reverse the defensive works on the left bank of the Seine.

At 8 a. m. the *Fulminant*, *Furieux*, and *Isly* entered the Seine, which placed the port at their mercy. At 9 a. m. the vessels drew off and the fleet steamed to the northward, finally anchoring at La Hougue. The torpedo vessel *Archer* was sent to Cherbourg to have defects in her cylinders repaired. July 19 the squadron passed the Straits of Calais, pretended to bombard and destroy Calais, while, at the same time, the protected cruiser *Isly*, with a torpedo vessel and two torpedo boats, attacked Wissant. During these attacks they were guarded against a sortie from Dunkirk by the protected cruisers *Jean-Bart* and *Surcouf*. These places decided destroyed, the squadron steamed full speed to Dunkirk, the object being to destroy it and repass the Straits before night. As previously instructed, the available torpedo boats, acting as buoys, rapidly took position along the edges of the shoals off Dunkirk, and the fleet, steaming in column, successively silenced the coast works at Gravelines and the defenses at Dunkirk. About 5 o'clock the squadron was again off Calais, where four torpedo boats and the torpedo vessel *Lance* were detached to simulate a landing and the destruction of the semaphore at Cape Gris-Nez. Owing to the state of the weather a real landing was not made. July 19 the *Zouave*, torpedo boat, first class, was escorted to Dieppe by the *Epervier*, owing to having developed leaks in her boilers. July 20 the squadron moored at Cherbourg.

The weather during most of the time was bad, but not bad enough to deter an enemy in real warfare from attempting to carry out with every prospect of success landings and destruction of semaphores, light-houses, bridges, railroads, etc. Light batteries would undoubtedly have been destroyed, and, while the heavier ones could resist attack successfully, they would be powerless to prevent the possible destruction of Havre itself.

The injuries to the torpedo boats *Archer* and *Zouave* can be attributed to the hurried way they were put into active service. It is impossible to handle delicate vessels of this type with green crews. Whatever may be the rapidity and system of mobilization, there must be a certain time allowed for officers and men to become accustomed to their vessel and to one another. Particularly is this true in regard to evolutions to enable the commanding officer to become acquainted with the manœuvring qualities of his vessel. These small vessels can not join a fleet within a day of mobilization without risk of serious injury.

During the operations both the attack and the defense were conducted with method and accuracy. The ships preserved their distances during attack and executed every evolution with precision. On shore the signal communication, both by telegraph and by semaphore, left nothing to be desired. This is considered a great step in advance over previous years.

PART II.—FORCING THE STRAITS OF DOVER.

The squadron was divided into two divisions. The FIRST DIVISION, supposed to be French—composed of the following-named vessels: SUFFREN, battleship; FURIEUX, TONNERRE, and FULMINANT, coast-defense vessels; ISLY and EPERVIER, protected cruisers; LANCE and SALVE, torpedo vessels; GRENADIER, LANCIER, ARCHER, AVERNE, and DAUPHIN, torpedo boats—would oppose the attempt.

The *Second Division*, supposed to be the enemy—composed of the following-named vessels: *Requin*, coast-defense vessel; *Victorieuse*, cruiser; *Surcouf* and *Jean-Bart*, protected cruisers—was to attempt to force the Straits from the north. This division, under the command of Rear-Admiral Ménard, left Cherbourg the evening of July 23; the FIRST DIVISION at 7 p. m. the 24th.

Besides attempting to force the passage the *Second Division*, if successful, was at liberty to attack any portion of the coast between the Belgian frontier and Cherbourg. For this reason the coast-defense vessels FULMINANT and TONNERRE were kept at Cherbourg by Vice-Admiral Brown of Colstoun, to guard the southern part of the threatened territory. For similar reasons the SUFFREN, battleship, FURIEUX, coast-defense vessel, and two torpedo boats were sent to the neighborhood of Havre.

A light division was formed of the ISLY, protected cruiser; EPERVIER, protected cruiser; SALVE, torpedo vessel, and three torpedo-boats, which scouted all night between the English coast and Calais, while the SUFFREN, the FURIEUX, and the other two torpedo boats, remaining within communicating distance, covered the coast from Barfleur to Zuydcoote. The coast-defense vessels TONNERRE and FULMINANT left Cherbourg the morning of the 27th for La Hougue to support the light squadron. The torpedo boats AVERNE and ARCHER lost touch with their squadron and put into Cherbourg for news the night of the 27th. They left to rejoin early on the 28th.

At midnight the enemy attacked La Hougue, and again after being joined by their cruisers at 5.30 a. m. The coast-defense vessels TONNERRE and FULMINANT coming to the relief of La Hougue, were joined by the protected cruisers ISLY, EPERVIER, torpedo vessels SALVE, LANCE, and torpedo boats ARCHER, AVERNE, and DAUPHIN, and immediately attacked the enemy off Querqueville. At this time the SUFFREN, battleship; FURIEUX, coast-defense vessel, and two torpedo boats were near Havre. Hostilities ceased with this attack about 6.30 a. m., and all the vessels steamed toward Douarnenez Bay, passing along the coast in front of Cherbourg.

The *Second Division* left Cherbourg the evening of July 23, anchoring the evening of the 24th off Ambleteuse, and leaving the following morning at 6 steamed slowly to the English coast above North Foreland. At 6 p. m. the division began the attempt to pass the Straits, and at 9.30 p. m. was south of South Foreland. The admiral, with the *Victorieuse*, armored cruiser, and *Requin*, coast-defense vessel, steaming at 9 knots, sent the cruisers ahead at 15 knots with lights extinguished. The *Jean-Bart*, protected cruiser, discovered the SALVE, torpedo vessel, and drove her off. Shortly afterwards the ISLY, protected cruiser, was discovered to port, and both vessels opened fire, the *Surcouf*, protected cruiser, came up and the ISLY was caught between two fires; in real warfare she would have been destroyed. The EPERVIER, protected cruiser, came to the rescue of the ISLY and joined in the battle. The *Victorieuse* and *Requin* passed the Straits during this action, keeping to the westward of Varne and as close to the land as possible. The ISLY and EPERVIER drew off.

At daylight on the 26th the division was off the Isle of Wight, watched from a distance by the ISLY, EPERVIER, and SALVE. When these saw the enemy steering south they steamed toward Havre to notify Admiral Brown. At 11 a. m. course was shaped for La Hougue, which place was bombarded at midnight by the *Victorieuse*, armored cruiser, and *Requin*, coast-defense vessel. At 4.30 a. m., July 27, when the *Jean-Bart* and *Surcouf* rejoined, they were chased by the cruisers of the FIRST DIVISION, with whom an action took place, and a few more shots were fired at the town, when the firing ceased. This terminated the second part of the manœuvres.

It would seem from the disposition made by the defense that two forces each nearly equal in strength to the enemy were posted at the two most important places on the coast—Havre and Cherbourg; but even this quasi equality would not obtain unless the light squadron could retain touch with the enemy and reenforce the coast defense at menaced points. The *Second Division*, although discovered while passing the Straits, succeeded in placing the ISLY twice under fire and made its way south unchecked. La Hougue was attacked without opposition and the bombardment had ceased before the arrival of the coast-defense vessels. The advantage rested with the *Second Division.* It was impossible for the FIRST DIVISION to prevent the *Second Division* from passing the Straits, and however well taken his dispositions the force at the disposal of Admiral Brown was not adequate for the task imposed upon it.

While these manœuvres were in progress an attack was made on Cherbourg to develop weak points in the defense and also to familiarize the personnel with their duties. During the 26th the *Cocyte*, armored gun vessel, and *Phlégéthon*, armored gun vessel, steamed about in front of the defenses at various distances, firing being carried on by determining distance and speed as in real warfare. The batteries were manned by the marine artillery and the army.

A night attack also was made by the *Cocyte* and *Phlégéthon*, favored by darkness. Unsuccessful efforts were made to enter the harbor through the western and also through the eastern entrance. After failure at the eastern entrance a second effort was made at the western entrance, but the gun vessels were discovered and driven off. Hostilities then ceased. The shore search lights were found to be very efficient.

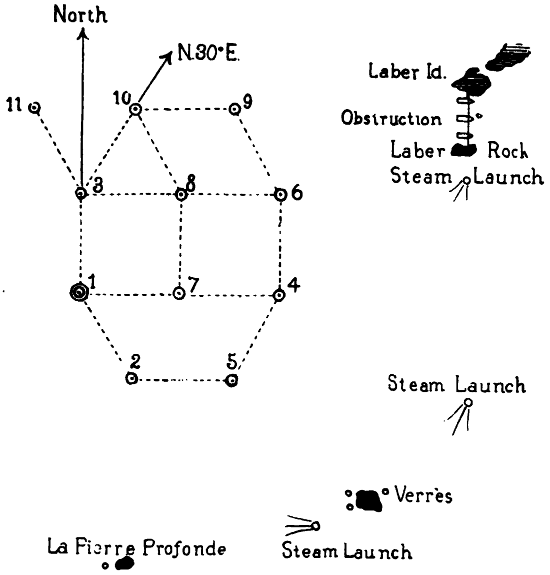
The *Cocyte* and *Phlégéthon* were attacked on the night of July 28, while under way, by torpedo boats and on the 30th, while at anchor, by 14 torpedo boats of the mobile defense of Cherbourg. Both attacks were successful, but no special features were developed.

THEME.

The following theme was given:

PART III.

An enemy's fleet represented by the Northern Squadron, having command of the sea, has unsuccessfully attacked Brest, with a certain amount of injury to the squadron resulting. The squadron anchors in Douarnenez Bay to repair. The Brest *défense mobile* flotilla attacks it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Laber Id.
Obstruction
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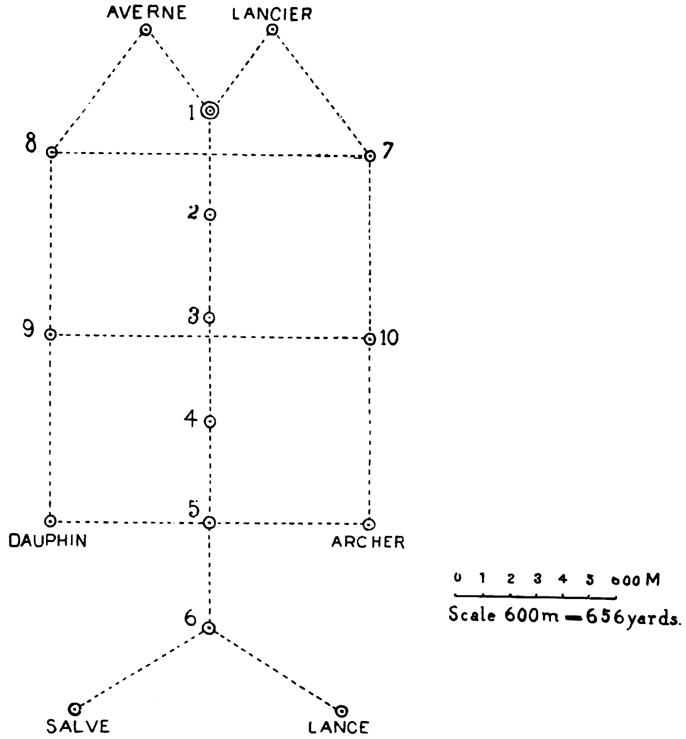
Steam Launch
Steam Launch
Verres
La Pierre Profonde
Steam Launch

Fig. 2.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1
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SALVE
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0 1 2 3 4 5 600 M
Scale 600m = 656 yards.

Fig. 3.

there. The following day, after effecting repairs as well as possible, the squadron, not judging it safe in the bay, weighs anchor and undertakes to reach one of its own ports at the speed of its most injured vessels. The torpedo flotilla, notified of its departure, attempts to attack it at sea.

The squadron anchored July 28 in Douarnenez Bay. The EPERVIER, protected cruiser, had been sent on in advance to place buoys. The anchorage was protected on the south by the Verrès rocks and La Pierre Profonde. The ships were anchored in an octagonal formation, each side about 400 meters (437 yards) long, with the ISLY, protected cruiser, and JEAN-BART in the center, the LANCE, torpedo vessel, to the northwest of the vessels to defend the approach from Morgat Point. Patrol boats were used to guard the approaches. The narrow pass between Laber Island and Laber Rock, although difficult at best, was presumed to be familiar to the Brest attacking force and was closed by a hawser stretched across boats. The larger pass between the Verrès and Laber Rock was guarded by steam launches equipped with search lights and armed with revolving cannon. Sectors to illuminate were assigned the torpedo vessels. (*See* fig 2.)

The Brest torpedo flotilla consisted of boats *No. 145*, flag boat of the commander commanding the *défense mobile* and also directing the operations, and *Nos. 61*, *73*, *75*, *80*, *81*, *83*, *84*, *136*, *137*, *17*, *21*, *23;* total 13. They were divided into four divisions, to act separately and in a manner previously determined. The torpedo-boat divisions left in succession for Douarnenez Bay about 10 p. m. The night was dark and cloudy, rain having just ceased falling, with a light wind and smooth sea.

About 11.35 the FULMINANT, coast-defense vessel, was torpedoed from a distance of less than 200 meters (218 yards). By the illumination produced by the search lights the position of all the ships was made out from the torpedo boats, and attacks continued until after 2 o'clock. A torpedo was discharged at the REQUIN, coast-defense vessel, by *No. 73* coming from the southeast without the patrol boats having seen her.

No. 145 made what probably was the most successful attack, at a distance of less than 100 meters (109 yards) from the *Suffren.* The attack, in spite of every precaution taken by the defense, was eminently successful, many of the ships being struck more than once.

At 2.10 a. m. hostilities ceased.

The LANCIER, torpedo vessel, left for Brest the 29th to have her distiller repaired.

At 4 p. m., July 29, the squadron got under way. According to previous agreement speed was limited to 7 knots, supposed to be that of the injured vessels. About 9 p. m. the formation against torpedo boats was taken, the armored vessels in column of vessels natural order, interval, 400 meters (437.3 yards), protected ahead, astern, and on both flanks by the cruisers and torpedo vessels, distance between columns 600 meters (656 yards). (*See* fig. 3.) The night was dark, with a fresh northwest breeze and a rising sea. About 10.30 p. m. a red light burned close aboard indicated the presence of a torpedo boat. The JEAN-BART opened fire at once and a regular mêlée ensued. In spite of the rough sea the torpedo boats were handled with great skill and passed among the ships of the squadron in all directions.

Anchored at Camaret, the flotilla waited news from the semaphores of the weighing of the squadron. Putting to sea immediately, they were able to make out the masts and rigging. Certain that the enemy would double Ushant, they took post about the Helle Channel, by divisions, and surrounded the squadron. Chance may have had something to do with their success, but should not detract from the merit due the calculations of the flotilla commander nor from the merit of the attack. All signal poles had been taken down, which rendered the discovery of the torpedo boats much more difficult. These torpedo attacks two nights in succession, and conducted by 13 boats acting in concert, were more successful than ever before, and though many conditions were unfavorable not an accident took place. The good results are attributed to the training acquired by the commanding officers navigating along a difficult coast where they are always on the alert and also to the good condition of the boats themselves.

This attack terminated the manœuvres.

CASUALTIES.

Archer, torpedo boat, first class: Injuries to cylinders; was sent to Cherbourg for repairs.

Grondeur, torpedo boat, first class: Slight fire, extinguished by force on board. Collision July 18 with *Jean Bart*, protected cruiser. Her bow was bent to port; put into Bologne, where she received sufficient repairs to enable her to reach Havre, where work on her was completed.

Zouave, torpedo boat, first class: Developed leaks in after boiler July 19; was escorted to Dieppe by the *Epervier*, protected cruiser.

Lance, torpedo vessel: Pipes of distiller injured; repaired at Brest.

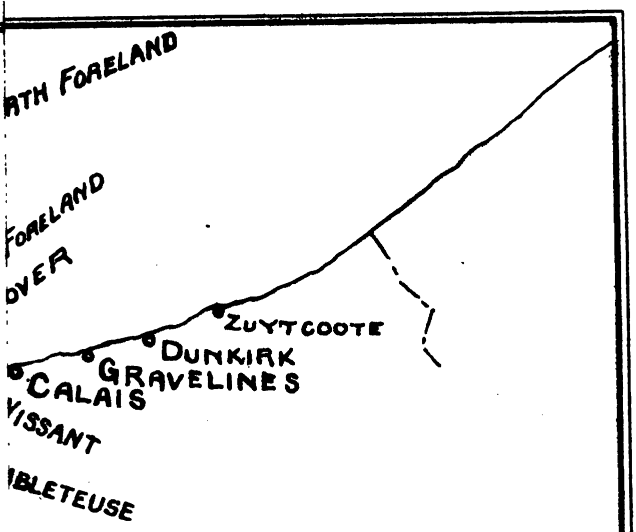
Nö. 146, torpedo boat, first class: Boiler tube burst; repaired at Cherbourg.

No. 165, torpedo boat, first class: Boiler tube burst; repaired at Cherbourg.

THE MEDITERRANEAN.

The *réservistes* began to embark July 9 aboard the mobilized vessels. In the meantime the active and reserve squadrons, under the command of Vice-Admiral Baucheron de Boissoudy, had left port July 2, and exercised in evolutions and in receiving torpedo attacks at anchor and under way.

The fleet returned to Toulon July 9, where ships filled up with coal, provisions, etc., and the *réservistes* embarked.



NAVAL MANŒUVRES OF 1894.

— NORTHERN COAST —

The following program of the manœuvres was issued by Vice-Admiral de Boissoudy:

July 9 to 16, fill up with stores at Toulon; 16 to 29, exercise at scouting and getting torch with other squadrons in the northwest basin of the Mediterranean, limited to the southward by a line from Ajaccio to Cabrera (Balearic Islands). Raising a blockade. Battle firing will complete these manœuvres. July 30 to August 3, separate squadron exercises; the active squadron about Corsica, the reserve squadron on the coast of Provence.

MEDITERRANEAN FLEET.

Vice-Admiral Baucheron de Boissoudy, commander in chief.

ACTIVE SQUADRON.

Rear-Admirals Gadaud and Le Bourgeois.

Ship.	Class.	Date of launch.	Displacement.	Guns, main battery.	Maximum speed.	Complement.
					Knots.	
Formidable (flag)	Battleship	1885	9,700	12	16.2	640
Dévastation (flag)	...do	1879	9,639	14	14	685
Hoche	...do	1886	11,300	22	16.2	660
Marceau	...do	1887	12,000	21	17.5	660
Magenta	...do	1890	10,600	21	17.5	660
Neptune	...do	1887	10,630	21	16.5	660
Amiral Duperré	...do	1879	10,487	21	14.3	664
Amiral Baudin	...do	1883	8,320	15	15.2	630
Courbet	...do	1881	9,652	14	15.4	669
Alger	Protected cruiser, first class.	1889	8,200	10	19.6	325
Tage	...do	1886	7,345	24	19.1	400
Lalande	Protected cruiser, third class.	1889	1,877	4	19.5	190
Faucon	...do	1887	1,240	5	17	134
Vautour	...do	1889	1,280	5	17	134
Watigniès	...do	1891	1,310	5	18.6	180
Léger	Torpedo vessel	1891	450	1	18.8	69
Lévrier	...do	1891	450	1	18.5	69
Bombe	...do	1885	395	4	18	63
				Torpedo tubes.		
Corsaire	Torpedo boat, first class.	1893	170	2	25.5	32
Mousquetaire	...do	1892	150	2	25.4	32
Audacieux	...do	1889	103	3	20.3	27
Kabyle	...do	1891	106	2	21.5	27

RESERVE SQUADRON.

[Vice-Admiral de la Jaille and Rear-Admiral Prouhet.]

Ship.	Class.	Date of launch.	Displacement.	Guns, main battery.	Maximum speed.	Complement.
					Knots.	
Richelieu (flag)	Battleship	1873	4,240	19	13.2	720
Indomptable	Coast-defense vessel	1883	7,168	6	14.8	332
Colbert (flag)	Battleship	1875	8,457	16	14.4	706
Caïman	Coast-defense vessel	1885	7,200	6	15	332
Terrible	do	1881	7,713	6	14.5	332
Sfax	Protected cruiser, first class.	1884	4,502	16	16.7	473
Forbin	Protected cruiser, third class.	1888	1,848	4	20.6	190
Milan	Cruiser, third class	1884	1,550	5	18	186
Condor	Protected cruiser, third class.	1885	1,240	5	17.7	134
Dague	Torpedo vessel	1885	395	4	18	63
Flèche	do	1885	395	4	18	63
				Torpedo tubes.		
Orage	Torpedo boat, first class	1891	106	2	21.5	27
Éclair	do	1891	106	2	21.5	27
Agile	do	1889	103	3	20.4	27
Aventurier	do	1889	148	4	20.5	30

MOBILIZED.

Ship.	Class.	Date of launch.	Displacement.	Guns, main battery.	Maximum speed.	Complement.
				Torpedo tubes.		
ACHÉRON	Armored gun vessel	1885	1,640	4	13	101
FUSÉE	do	1884	1,150	2	13	84
MITRAILLE	do	1886	1,130	2	13	84
				Tubes.		
No. 85	Torpedo boat, second class.	1885	54	2	20	16
No. 94	do	1886	54	2	20	16
No. 96	do	1886	54	2	20	16
No. 98	do	1886	54	2	20	16
No. 101	do	1887	54	2	20	16
No. 108	do	1887	54	2	20	16
No. 178	Torpedo boat, first class.	1893	79	2	21	22
No. 178	do	1893	79	2	24	22
No. 180	do	1893	80	2	21	22
No. 181	do	1893	80	2	21	22

The fleet left Toulon the morning of July 16 and spent the day in separate manœuvres. The following days were devoted to target practice and various exercises. The night of the 21st the fleet left Salins-d'Hyères in separate divisions. The *Formidable*, battleship, and two armored vessels went south. The *Marceau*, battleship; *Caïman*, coast-defense vessel; *Condor*, protected cruiser; *Flèche*, torpedo vessel; *Corsaire*, torpedo boat, first class; *Mousquetaire*, torpedo boat, first class, and several smaller torpedo boats went east to attack St. Raphael at daybreak, and also to destroy the semaphore at Drammont, close by. About 6.30 a. m. the *Admiral Baudin*, battleship, joined, and landing parties seized St. Raphael. At noon hostilities ceased. At the same time the Reserve Squadron took possession of the Gulf of Juan.

The division of the Active Squadron under the command of Rear-Admiral Le Bourgeois rejoined from the North African coast July 23, where similar exercises had been conducted.

The search for an armored squadron was conducted by a light squadron composed of an equal number of cruisers. The division under Rear-Admiral Prouhet, representing the armored vessels, put to sea. In fifteen hours after the search began the armored fleet was discovered by the *Wattignies*, protected cruiser. The same light squadron was required to maintain touch with an enemy's force and also to convey the information of its whereabouts to friendly armored vessels. The *Wattignies* was charged with maintaining touch and furnishing information of the enemy's movements, change of route, etc.

A stratagem, almost successful, executed before moonrise was defeated by a torpedo-boat attack begun upon the SFAX, protected cruiser, first class. The enemy's cruisers had directed all their electric search-lights upon the *Wattignies*, protected cruiser, and had thus blinded those on board to the movements of the heavy vessels. When the attack developed, the cruisers were compelled, however, to use their lights for their own protection, thus enabling the *Wattignies* to observe and signal to the *Alger*, protected cruiser, first class, the enemy's change of course, which information was conveyed by dispatch vessel to the *Dévastation*, battleship, 50 miles distant. This system of communication seems to work well, but the return of the dispatch vessels has not yet been provided for.

Maintaining touch with the enemy has given rise to much discussion, and, while some hold that it is very easy to keep touch with the hostile vessels, others, and mostly captains of cruisers, take the opposite view. French authorities appear to agree that 3,000 meters (3,281 yards) is about the distance from which touch can be maintained.

A second attack was made upon St. Raphael, and a large landing party composed of infantry and artillery took possession. While these operations were in progress, the ACHÉRON, armored gun vessel, and 13 torpedo boats of the Toulon *défense mobile* reconnoitered the coast from Toulon to the Spanish frontier. Much benefit was derived from this method of practical instruction. St. Tropez was blockaded by a hostile squadron, which also attempted to cut all land communications. The defending squadron, supposed to be much inferior, was compelled to remain passive, but relied for relief upon an allied squadron which was to attempt to effect junction. In spite of every effort on the part of the blockading squadron, junction was effected at night and the blockading squadron driven off by the combined forces. The blockade was maintained for about 72 hours.

Publicity is not given to these operations as they are regarded as particularly of national importance. It is known, however, that the fast cruisers were very efficient.

July 28 the combined operations terminated, the Reserve Squadron anchored at Salins-d'Hyères, and the Active Squadron at Ajaccio, Corsica. Later, the Reserve Squadron reconnoitered the coast on both sides of Toulon, engaging the groups of torpedo boats attached for the time to the armored gun vessels ACHÉRON, MITRAILLE, and FUSÉE.

On the Corsican coast the manœuvres were mainly to test the efficiency of torpedo boats operating for coast defense.

The following is a list of torpedo boats belonging to the *défense mobile* that took part in the manœuvres near Ajaccio:

Torpedo boats.	Class.	Date of launch.	Displacement.	Torpedo tubes.	Maximum speed.	Complement.
					Knots.	
No. 176	1	1893	79	2	21	22
No. 126	1	1889	75	2	21	22
No. 127	1	1889	75	2	21	22
No. 104	2	1886	54	2	20	16
No. 135	2	1890	54	2	20	16
No. 140	2	1890	54	2	20	16

During the night of July 31 the torpedo boats were exercised searching for a cruiser at sea protected by torpedo vessels. Another night the MAGENTA, battleship, was anchored in one of the bays in the Gulf of Ajaccio, and was attacked there by all the torpedo boats belonging to the squadron and two belonging to the defense. All torpedoes used were fitted with exercise heads (*cônes d'écrasement*) to indicate hits. The ADMIRAL DUPERRÉ, battleship, was also used to represent a man-of-war in friendly waters attacked by a fleet of hostile torpedo boats. Any means of defense available from her own resources was employed. No special features were developed in any of these operations. The exercises terminated August 3.

CASUALTIES.

Mousquetaire, torpedo boat, first class: Fell foul of the *Audacieux*, torpedo boat, first class, July 26. Her bow was seriously damaged and she had difficulty regaining St. Raphael. Later she was towed to Toulon by the *Dague*, torpedo vessel.

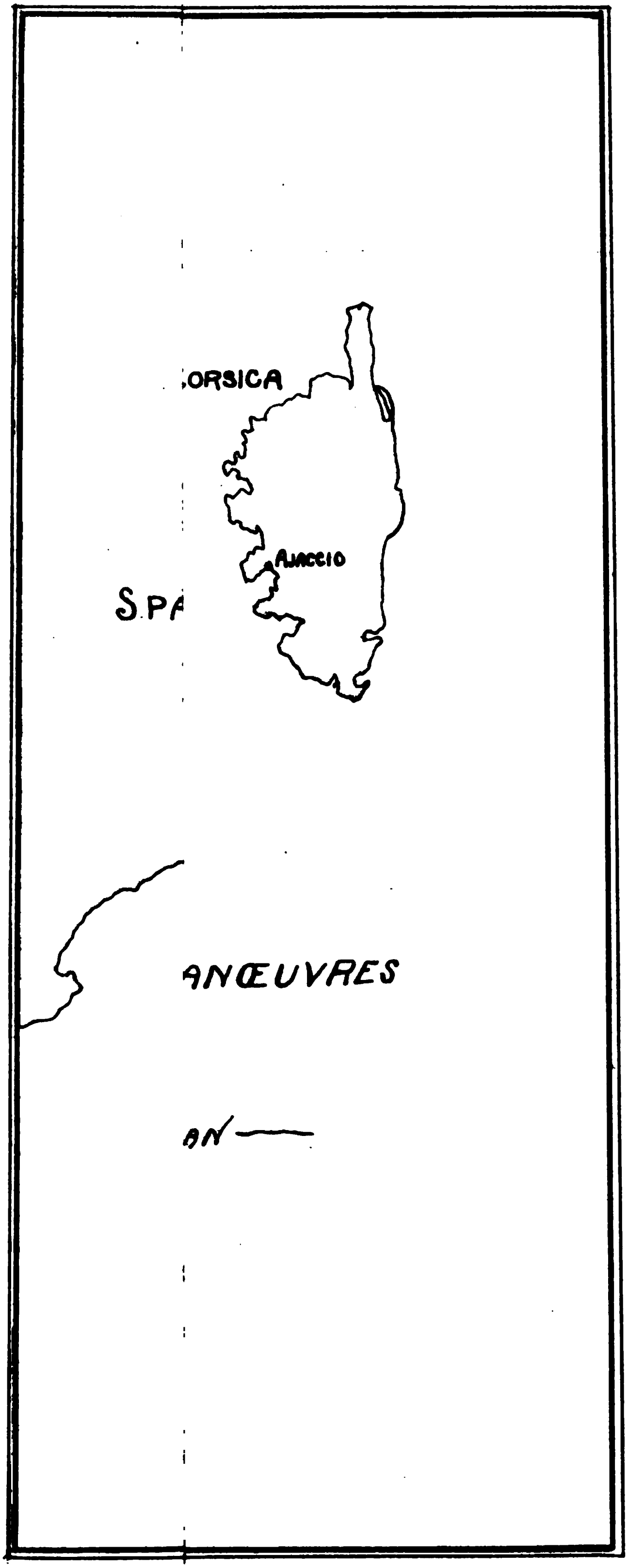
Audacieux, torpedo boat, first class: Injured by collision with *Mousquetaire;* was towed to Toulon by the *Forbin*, protected cruiser, third class.

Formidable, battleship: Slight injury to machinery; repaired by force on board.

COMMENTS.

In the Atlantic and Channel the operation of the new system of coast defense was found to be satisfactory, but it is regarded as not yet complete. It is thought that an alert enemy could effect landings at various points along the coast, destroy signal communication, and possibly prepare the way for the landing of an army. Attacking isolated batteries is, for a fleet, a risky and unprofitable operation unless it is intended immediately to precede a serious attempt to effect a landing. The risk is much enhanced when the attack is directed against a position defended by batteries, coast-defense vessels and torpedo boats. General Borguis-Desbordes, investigating the effect of bombardment upon Marseilles, allowed a hostile fleet to discharge 6,000 projectiles, which he considers more than could be thrown in reality. He concludes that 3 houses out of every 1,000 would be destroyed. Will it pay, then, to risk the loss of one or more appreciable units of maritime supremacy for the doubtful benefit resulting from a bombardment? Apparently not while the enemy's fleet is in a condition to keep the sea.

It is a truism to state that torpedo boats to be efficient must be in good condition and well handled, but the operations near Brest emphasized this as never before. It is said by those capable of judging that the dispositions taken by the ships were the best possible, yet the success of the torpedo boats was pronounced, and neither the darkness of the nights nor the heavy sea the second night, prevented them from approaching close to the ships or from passing through the squadron. An efficient torpedo-boat flotilla resolutely commanded still remains a source of serious danger to a fleet on a hostile coast.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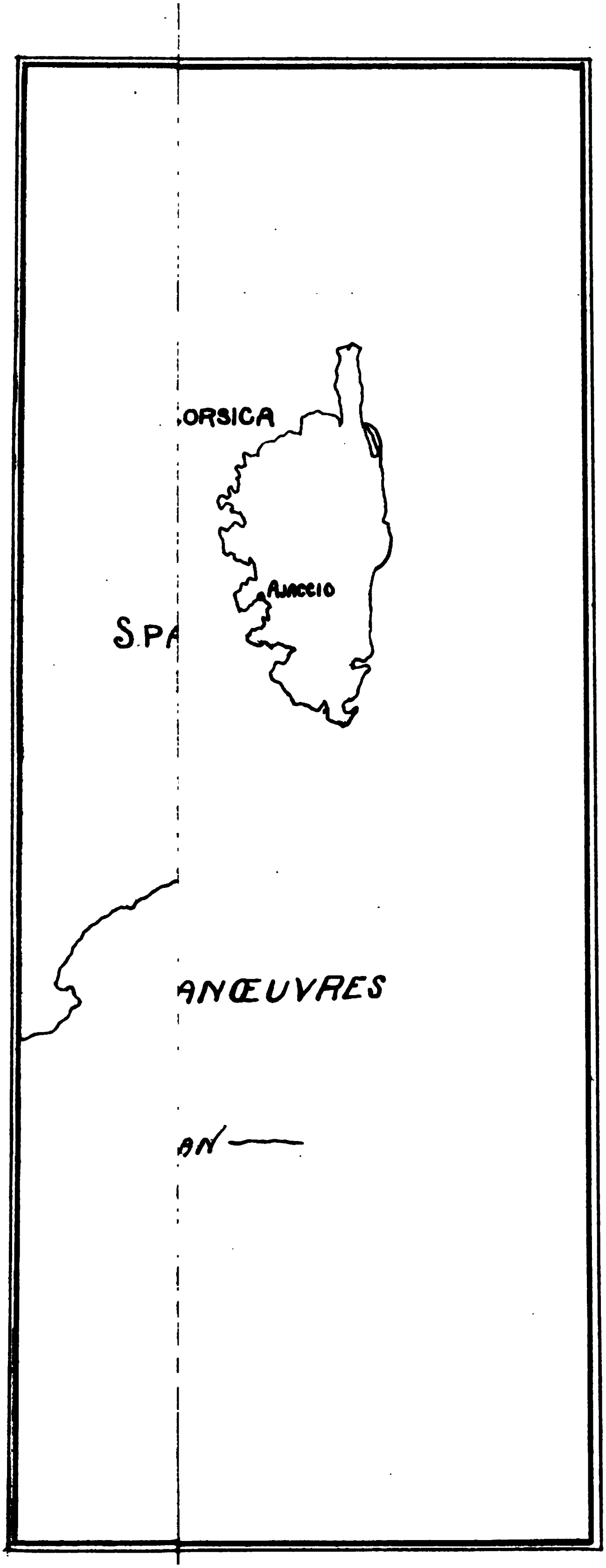
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VIII.

PRELIMINARY NOTES ON THE JAPAN-CHINA WAR.

By Lieut. H. M. **Witzel**, United States Navy,
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Staff Intelligence Officers.

[Note.—As the full data necessary for the publication of a volume of the War Series are not yet available, the following brief account of the war in Eastern Asia is printed at the present time to give a general idea of the sequence of events, without comments or deductions. The naval action off the mouth of the Yalu River is treated more in detail because the printed information is in general of such a contradictory character; for the sake of clearness, however, the illustrated diagrams are made as simple as possible. The same may be said in connection with the map of the theater of war.—Editor.]

THE OUTBREAK OF THE WAR; POUNG DO AND ASAN.

In the spring of 1894 an insurrection broke out in Korea which the national troops were unable to suppress, and the Government about June 1 called on China for aid. China decided to give the required assistance, and on June 7 notified Japan, in accordance with the provisions of the Tientsin convention of April 18, 1885, of her intention to send troops to Korea to suppress the disturbance. On the same day (June 7) Japan informed China, in accordance with the terms of the convention, that owing to the grave nature of the disturbances in Korea the presence of Japanese troops there would be necessary and that it was the intention of the Imperial Government to send a body of troops.

The first detachment of Chinese troops landed at Asan (*see* map, pocket of cover), near the head of Prince Jerome Gulf, about 40 miles south of Seoul, on June 9; a second on June 11—about 2,000 troops in all.

On June 9, the same day that the first Chinese detachment landed at Asan, a body of about 500 men landed from the Japanese fleet at Chemulpo, the seaport of Seoul, and moved to Seoul. These men were soon relieved (June 12) by troops of the V Division (Hiroshima) of the Japanese army. By the beginning of July Japan had sent to Korea the whole of the V Division serving with the colors, about 8,000 men, stationing about 1,000 at Gensan, on the northeast coast, 1,000 at Fusan, on the southeast coast, and the rest at Seoul and Chemulpo. Transports were hired and prepared for the transportation of men and material, all of the available ships of the navy put in commission for service, preliminary notice served on the first reserves of the army for speedy mobilization, and war material of all kinds accumulated at convenient bases, so that when hostilities actually broke out Japan was able to send rapidly into the field well-equipped armies, fully protected while in transit.

In the meantime Japan, claiming that it was necessary to establish a stable government in Korea, under which her commerce, already large, might peacefully increase without interruptions from frequent insurrections and uprisings, proposed to China that certain changes in the methods of the internal administration of Korea be made under their joint supervision. China would not agree to these proposals, and intimated that the insurrection which had furnished the reason for the introduction of Japanese troops into Korea was suppressed and that, therefore, the troops should be withdrawn. The Japanese Government, however, "considered that the juncture was opportune for a definite settlement of the whole Korean question," and on July 14 informed the Chinese Government that "in this juncture the Imperial Japanese Government find themselves relieved of all responsibility for any eventuality that may in future arise out of the situation." And when, a little later, China began to assemble transports for sending additional troops to Korea, military considerations determined Japan's action.

For active service in war Japan had available the ships given in the following table:

JAPANESE FLEET.

Name.	Class.	Displacement.	Speed, maximum. Knots.	Completed.	Remarks.
Matsushima ✓	Coast-defense vessel.	4,277	16	1891, France..	Yalu, Weihaiwei.
Itsukushima ✓	.....do	4,277	16.8	.....do	Do.
Hashidate ✓	.....do	4,277	16	1894, Japan...	Do.
Fuso ✓	Armored cruiser....	3,717	13.2	1878, England.	Yalu.
Chiyoda ✓	.....do	2,450	19	1890, England.	Do.
Hiyei ✓	Protected cruiser...	2,250	14	1878, England.	Do.
Kongo ✓	.....do	2,250	14	.....do	
Naniwa ✓	.....do	3,650	18.9	1886, England.	Poung Do, Yalu, Weihaiwei.
Takachiho ✓	.....do	3,650	17.9	.....do	Yalu, Weihaiwei.
Yoshino ✓	.....do	4,150	23	1893, England.	Poung Do, Yalu, Weihaiwei.
Akitsushima ✓	.....do	3,150	19	1894, Japan...	Do.
Tsukushi ✓	Gun vessel..........	1,350	16.8	1883, England.	
Banjo	Cruiser	656	....	1880, Japan...	
Amagi	.....do	1,030	....	1878, Japan...	
Kaimon	.....do	1,358	....	1884, Japan...	
Tenriu	.....do	1,547	....	1885, Japan...	
Katsuragi	.....do	1,476	....	1887, Japan...	
Yamato	.....do	1,476	....	.....do	
Musashi	.....do	1,476	....	1888, Japan...	
Takao ✓	.....do	1,774	....	1889, Japan...	
Yaeyama ✓	Partially protected cruiser.	1,600	....	1890, Japan...	Dispatch vessel.
Oshima	.....do	639	....	1892, Japan...	
Maya	Gun vessel..........	614	13	1890, Japan...	
Atago	.....do	614	....	.....do	
Akagi	.....do	614	....	.....do	Yalu.
Chokai	.....do	614	....	.....do	

These ships were organized into a *Main* and four *Auxiliary Squadrons*. The *Main Squadron* consisted of the coast-defense vessels *Matsushima*, *Itsukushima*, and *Hashidate* and the armored cruiser *Chiyoda;* the *First Squadron* of the protected cruisers *Yoshino*, *Takachiho*, *Akitsushima*, and *Naniwa;* the *Second Squadron* of the armored cruiser *Fuso*, the protected cruisers *Hiyei* and *Kongo*, and the cruiser *Takao;* the *Third Squadron* of the cruisers *Katsuragi*, *Yamato*, *Musashi*, and *Tenriu;* the *Fourth Squadron* of the small cruisers *Banjo* and *Oshima* and the gun vessels. The squadron organization was generally maintained, although it was occasionally necessary, for special purposes, to transfer ships from one squadron to another temporarily. Sixteen torpedo boats were organized in three divisions—the *First* and *Second* consisting of 6 boats each and the *Third* of 4 boats.

Opposed to the Japanese fleet China had her NORTHERN or PEIYANG SQUADRON reenforced by the 3 third-class cruisers KUANG YI, KUANG KIA, and KUANG PING, from the squadron of the Kuang provinces. There were also 15 torpedo boats. The ships utilized are given in the following table:

Name.	Class.	Displacement.	Speed, maximum.	Completed.	Remarks.
			Knots.		
Chen yuen	Battleship	7,430	15.5	1883, Germany	Yalu, Weihaiwei; captured.
Ting yuen	do	7,430	15.4	do	Yalu, Weihaiwei; sunk.
King yuen	Coast-defense vessel	2,900	15	1887, Germany	Yalu, sunk.
Lai yuen	do	2,900	15	do	Yalu, Weihaiwei; sunk.
Tsi yuen (Chi yuen)	do	2,355	17.5	1884, Germany	Poung Do, Yalu, , Weihaiwei; captured.
Ping yuen	do	2,600	10.5	1890, Fuchau	Yalu, Weihaiwei; captured.
Ching yuen	Protected cruiser	2,300	18.5	1887, England	Yalu, Weihaiwei; sunk.
Chih yuen	do	2,300	18.5	do	Yalu; sunk.
Yung wei	Gun vessel	1,350	16.2	1881, England	Do
Chao yung	do	1,350	16.2	do	Do
Kuang yi	Third-class cruiser	1,030	16.5	1891, Fuchau	Poung Do; sunk.
Kuang ping	do	1,030	16.5	do	Yalu, Weihaiwei; captured.
Kuang kia	do	1,030	16.5	do	Yalu; wrecked escaping from.
Wei yuen	Old corvettes	1,300			Weihaiwei; sunk.
Kang chi		1,300			Weihaiwei; captured, disarmed, and returned to China.
Tsao kiang (Chao kiang).	Dispatch vessel	500			Poung Do; captured.
Chen pai	Gun vessels	440			The alphabetical gun vessels. Weihaiwei; captured.
Chen pien					
Chen li					
Chen chung					
Chen nau					
Chen tung					

The Japanese army consisted of six divisions and the imperial guard. With the colors, these divisions averaged over 9,000 men, first reserve about 15,000, and second reserve about 17,000. These figures for the guard were 6,500, 8,600, and 5,500. During the war the force with the colors was swelled by drafts from the reserves, so as to bring the divisions up to an average war strength of 13,000 or 14,000 men of the several arms.

The First Army, which operated in Korea and subsequently invaded Manchuria, commanded at first by Field Marshal Yamagata, was composed of the III and V Divisions under command of Lieutenant-Generals Katsura and Nodzu.

The Second Army, engaged in the capture of Port Arthur, and a division of which afterwards supported the First Army in Manchuria, was commanded by Field Marshal Oyama and consisted of the I Division, Lieutenant-General Yamaji, and the twelfth brigade, VI Division, Major-General Hasagawa.

The land force sent against Weihaiwei was also commanded by Field Marshal Oyama; it was made up of the II Division, Lieutenant-General Sakuma, and the eleventh brigade of the VI Division, Lieutenant-General Kuraki.

The paper strength of the Chinese army was about 1,000,000, but it is believed that only from 150,000 to 200,000 had modern arms, and these of various systems and calibers, and the army of Li Hung Chang, Viceroy of Pechili, about 55,000 strong, formed the only body whose organization, equipment, and training were approximately modern, and which was ready to take the field.

July 23, 1894.

On July 23 the Japanese, claiming that an attempt had been made to abduct the King of Korea and carry him to the Chinese camp, sent troops to the palace and posted guards at the gates, during which shots were exchanged between them and the Korean palace guards. After this Japanese troops were kept posted about the palace.

On July 22 China sent eight transports, carrying troops, from Taku, at the mouth of the Peiho, western end of the Gulf of Pechili. Among them were the S. S. "Feiching" and "Irene," under British colors, whose sealed orders, opened at sea, directed them to go to Asan. At 5.30 p. m., July 23, the S. S. "Kowshing," also under British colors, with about 1,200 men on board, followed the "Feiching" toward Asan. The "Feiching" and "Irene" reached the anchorage off Asan in the afternoon of July 24 and found there the Chinese coast-defense vessel TSI YUEN (CHI YUEN) and cruiser KUANG YI that were to cover the landing. The "Feiching" finished debarking during the forenoon of July 25 and started on her return to China before noon of that day. The two transports brought General Yeh, in command at Asan, a reenforcement of about 2,000 men.

During the afternoon of July 24 a Japanese man-of-war was sighted off the entrance to the Prince Jerome Gulf from the TSI YUEN, and

July 25.

later in the evening the WEI YUEN, an old corvette, arrived from Chemulpo, bringing news of the occurrences in Seoul on July 23. It was then determined to take the war ships back to China. Accordingly the WEI YUEN left about 2 a m., July 25, followed by the TSI YUEN and KUANG YI about 4.30. The two latter, about 7 a. m., while off the island of Poung Do, met the Japanese protected cruisers *Yoshino*, flying the flag of Rear-Admiral Tsuboi, *Akitsushima*, and *Naniwa*. An action followed in which the *Yoshino* and *Akitsushima* engaged the TSI YUEN and injured her turret, conning tower, and steering gear. In the meantime the *Naniwa's* gun fire had so damaged the KUANG YI that her commander was compelled to run her aground on one of the shoals off the entrance to Caroline Bay. The *Naniwa* then rejoined the other two ships and with them pursued the TSI YUEN, whose relieving tackles had been hooked, toward Shopajul Island, one of the most southern of the islands of the Prince Imperial Archipelago, in about latitude 37° 6′ north, longitude 126° east. On opening the south side of the island the transport "Kowshing" was made out standing in from the westward and, farther to the southward, the Chinese dispatch vessel TSAO KIANG bound from Chifu to Asan.

At about 9 a. m. the "Kowshing" anchored about a mile from Shopajul Island in obedience to a signal from the *Naniwa*, and an officer from the latter boarded her. About 11 a. m. the *Yoshino* continued in pursuit of the TSI YUEN and the *Akitsushima* of the TSAO KIANG, which latter had started to return to China as soon as it was seen that the "Kowshing" had been stopped, while the *Naniwa* directed the "Kowshing" to weigh and follow her. The Chinese, officers and men, on board the "Kowshing" prevented her English officers from carrying out the *Naniwa's* signal; and after another visit from a Japanese boarding officer and the exchange of several signals the *Naniwa*, at about 12.30 p. m., discharged a torpedo at the "Kowshing" and also opened fire, sinking her in a half hour. The *Naniwa* stood off and on, having picked up a few of the survivors, until evening, when she anchored in company with the *Yoshino*, whose chase of the TSI YUEN had been unsuccessful, and of the *Akitsushima*, which had overhauled the TSAO KIANG about 2 p. m. and brought her back. At daybreak of July 26 the vessels steamed south to the temporary base of the fleet, probably at the Kokun Islands (Kokun tao), a small group off the southwest coast of Korea in latitude 35° 50′ N., longitude 126° 25′ E., where the prisoners were transferred to the dispatch vessel *Yayeyama* for transportation to Japan.

July 25.

On July 25 Major-General Oshima marched out of Seoul with a force of about 3,500 men for Asan, where the Chinese were intrenched. After the advance guard of one of the Japanese attacking columns had received a check at the hands of the Chinese the latter were encountered in force at Seikwan, several miles from Asan, on July 29, and defeated. During the night the main position at Asan was abandoned, a quantity of military stores of various kinds being left behind. Of the escaping Chinese a considerable number, under the commanding general, Yeh, succeeded in reaching Pingyang, Province of Pingan, Korea, the latter part of August by a circuitous route, passing to the eastward of the capital. The Japanese troops returned to Seoul.

PINGYANG AND THE YALU.

Formal declarations recognizing a state of war were published by **July 31.** the Government of China on July 31 and by the Government of Japan on August 1. **Aug. 1.**

The immediate duty assigned to the Japanese fleet was to maintain safe sea communications between Chemulpo and Japan, and this was successfully done. The fleet apparently operated from a temporary base in the neighborhood of the Kokun Islands (Kokun tao), keeping its covering vessels advanced as far as the line from Shantung Promontory to Cape Choppeki, and even looking into Pingyang Inlet. Behind this screen the reserves of the V Division of the Japanese army, with war material of all kinds, were sent to Korea as rapidly as they could be prepared.

The Chinese fleet, it seems, made no attempt to interrupt the Japanese transport service; it remained in the Gulf of Pechili, except some of the smaller vessels that, on occasion, without being disturbed in this duty by the Japanese, convoyed transports from Port Arthur, the Chinese naval station at the southwestern extremity of the Kwangtung Peninsula, to the Yalu River, the northwestern boundary of Korea.

On the morning of August 10 a Japanese fleet of 12 vessels, accompanied by 6 torpedo boats, appeared off Weihaiwei, a fortified harbor on the south side of the entrance to the Gulf of Pechili, about 25 miles west of Shantung Promontory, and exchanged a few shots with the forts. Finding that none of the large vessels of the Chinese fleet were in the harbor the fleet returned to the coast of Korea.

About the middle of August the Japanese, leaving a garrison at Seoul, took up the march for Pingyang, in the north of Korea, where the Chinese were assembling in considerable force, some crossing the border from Manchuria, a Province of the Chinese Empire, and others having been sent by sea from Taku, Province of Pechili. One battalion of Japanese infantry and a company of artillery left Gensan for Pingyang, the march being so directed that a junction was effected with one of the columns marching north from Seoul before Pingyang was reached. On August 21 the remainder of the V Division, probably the first reserves, arrived at Chemulpo on 13 transports, and, the landing being completed on the 25th, marched north to assist in the movement against Pingyang, Lieutenant-General Nodzu commanding the division. The latter part of August one brigade, about 8,000 men of the III Division, was landed at Gensan, on the east coast, whence Colonel Sato with between 4,000 and 5,000 men set out across the mountains for Pingyang.

On September 10 the whole of the Japanese fleet was concentrated on the west coast of Korea, covering the movements of a fleet of 35 transports and 1 hospital ship, carrying the second brigade of the III Division, about 9,000 men, the pontoon equipment which was afterwards used to bridge the Yalu, a large force of coolies, and great quantities of provisions and general military stores. Accompanying these troops, which did not arrive in time to take part in the battle of Pingyang, was Field Marshal Yamagata, sent to take command of the troops in the field. The transports reached Chemulpo on September 12 and 13, and the landing was effected under the immediate protection of six men-of-war. The rest of the fleet remained outside, with the *First Squadron* on the lookout in the direction of Weihaiwei, two of the ships appearing off that port on the morning of September 14.

The Japanese troops from Seoul and Gensan arrived near Pingyang, the Chinese position, on September 13. It is said that some skill had been shown in strengthening the place, naturally strong. The defending force is estimated at 15,000, while the Japanese are believed to have had about 17,000. The force coming from the south approached in three columns, one of which had been joined by the first detachment coming from Gensan. The advance works were attacked on the morning of September 15, the fighting lasting until dark. During the night the Chinese evacuated the city, retreating toward the Yalu River. On the 16th the Japanese occupied the place, sending a force in pursuit, but the retreating Chinese made no further stand on Korean territory.

Sept. 15.

On reaching the Yalu River the Japanese halted for some time to allow reenforcements to come up and to perfect their transport service. The Japanese force in Korea then consisted of the III and V Divisions, with small garrisons at Seoul, Fusan, and Gensan. There remained no organized Chinese forces in Korea.

On the evening of September 14 the united fleet, the ships covering the landing at Chemulpo excepted, proceeded to Pingyang Inlet, which was reached on the following morning. There Admiral Ito, the Japanese commander in chief, learned that the army had begun its advance on Pingyang, and sent 4 men-of-war, with the torpedo boats, up the river to cooperate with the army. With the remaining ships of the fleet in two squadrons, the Admiral left Pingyang Inlet on the evening of September 16 and proceeded in the direction of the island of Haiyun (Haiyun tao), about 75 miles northwest of Cape Choppeki. The *Main Squadron*, under his own immediate command, consisted of the *Matsushima*, coast-defense vessel, flagship; *Chiyoda*, armored cruiser; *Itsukushima*, coast-defense vessel; *Hashidate*, coast-defense vessel; *Hiyei*, protected cruiser; *Fuso*, armored cruiser, and *Akagi*, gun vessel. The *First Squadron*, Rear-Admiral Tsuboi commanding, consisted of the protected cruisers *Yoshino*, flagship, *Takachiho*, *Akitsushima*, and *Naniwa;* the "Saikyo Maru," an armed transport, accompanied the fleet.

The main body of the Chinese PEIYANG SQUADRON was off Taku on August 17, went into the basin at Port Arthur on August 19, and left for Weihaiwei on August 22. It sailed from Weihaiwei on September 12, returned on the 14th, and left again the same evening for Talienwan Bay, about 25 miles northeast of Port Arthur, where it met the smaller vessels of the squadron and several torpedo boats that had convoyed from Taku 5 transports having about 4,000 men, military stores, and several prominent Chinese officials on board. The united squadron, with its convoy, reached the mouth of the Yalu River on September 16, the transports immediately beginning the disembarkation under cover of the PING YUEN, coast-defense vessel; KUANG PING, cruiser, and the torpedo boats, while the remainder of the squadron anchored in deep water, 10 to 12 miles off shore. The squadron here anchored was under the command of Admiral Ting, and consisted of the battleships TING YUEN, flagship, and CHEN YUEN, flying the flag of Vice-Admiral Liu, the second in command; the coast-defense vessels LAI YUEN, KING YUEN, and TSI YUEN (CHI YUEN); the protected cruisers CHING YUEN and CHIH YUEN; the gun vessels CHAO YUNG, YUNG WEI, and KUANG KIA. It is reported that 4 alphabetical gunboats and 6 torpedo boats arrived with the fleet, and that the former and 4 of the latter remained in the river and took no part in the action.

Sept. 17. From the anchorage smoke was seen to the southwestward at 10 a. m. on the 17th, and Admiral Ting got his squadron under way in line of battle, the two battleships in the center, the smaller ships on the flanks, the two torpedo boats and their consorts at a considerable distance under cover of the fleet, and at a slow speed steamed to meet the approaching ships, which proved to be the Japanese fleet, under Admiral Ito, that had reconnoitered the island of Haiyun (Haiyun tao) early that morning, and, having found no Chinese ships there, was proceeding toward the island of Talu (Talu tao), about 20 miles WSW. of the mouth of the Yalu. At 11.30 a. m. smoke was observed from the Japanese fleet on the starboard bow, bearing ENE. At 12.05 p. m. the ships were ordered to clear for action, and the S. S. "Saikyo Maru" and *Akagi* directed to take position on the port side of the *Main Squadron.* The fleet was moving in column, the *First Squadron* leading, the ships in the order in which they have been enumerated above, and the column formation was preserved throughout the action.

The leading or *First Squadron* at first headed for the center of the Chinese line, then gradually altered course to port to pass its right wing; the *Main Squadron* performed a similar evolution. From the Japanese ships the Chinese fleet appeared to be formed either in an irregular line or an echelon, and it was recognized that the TING YUEN and CHEN YUEN were in the center, with the sister ships CHING YUEN and CHIH YUEN, LAI YUEN, and KING YUEN on either side, and the other inferior ships on the flanks. During the approach 2 Chinese ships were seen on the port bow, off the right flank of the Chinese fleet.

At 12.50, when the *First Squadron* had approached to a distance of about 6,000 yards, the Chinese fleet opened fire. The *First Squadron*, continuing its movement toward the Chinese right flank, when it had approached to a distance of about 3,000 yards, opened a vigorous fire, which it maintained while passing. After passing the flank it turned to port toward the PING YUEN, KUANG PING, and the 2 torpedo boats. These, however, avoided the attack, and the squadron, on signal from the flagship, continued its movement to port to hasten to the assistance of the *Hiyei* and *Akagi*. Keeping bows on the enemy, according to Admiral Ting's plan of battle, the Chinese ships gradually changed course to starboard as the main Japanese squadron approached the right flank of their line. Of the rear ships of the latter the *Fuso* passed close in front of the Chinese line; but the *Hiyei*, which had lost distance, fearing she would be rammed if she remained in column, passed through the Chinese line between the CHEN YUEN and the KING YUEN, and suffered such injuries that she withdrew from the action under the protection of the remaining ships of the *Main Squadron* that had, in the meantime, turned the Chinese right flank, and was now advancing along the rear of their fleet.

The *Akagi*, being slow, was soon uncovered by the *Main Squadron* and exposed to the attack of the ships of the Chinese left wing. She was closely pressed by the LAI YUEN until the latter was set on fire and disabled, when the *Akagi* was able to withdraw from the action. It was to come to her assistance that the *First Squadron* had been recalled and was now fiercely attacking along the front of the Chinese line, while the *Main Squadron* was attacking along its rear. This combined attack was maintained with great vigor for a time, the Japanese ships gradually withdrawing to long-range distance.

The "Saikyo Maru" had maintained her position on the left flank of the *Main Squadron* until the column turned to starboard, then, passing through the returning *First Squadron* between the *Akitsushima* and *Naniwa*, she was exposed to an attack by the PING YUEN, KUANG PING, and the two torpedo boats that had returned toward the scene of action when the *First Squadron* went to the assistance of the *Akagi*. She was under fire for some time, receiving considerable injuries, though her speed finally enabled her to run out of range. One of the torpedo boats, at short range, discharged three torpedoes at her that did not strike.

During the first stage of the action the Chinese fleet had lost all semblance of formation. The CHAO YUNG and YUNG WEI, the starboard flank ships, disabled and on fire, were heading for shoal water off Talu tao. The YUNG WEI reached shoal water before she sank, her crew being taken off by one of the torpedo boats. The CHAO YUNG sank in deep water, possibly rammed by the TSI YUEN, which, with the KUANG KIA, was fleeing from the battle. These two ships, which at the beginning of the action had been on the left flank and somewhat in rear, fell still farther to the rear as the fleet made its slow wheel to starboard and were cut off from it when the Japanese *Main Squadron* passed along its rear. The CHIH YUEN had received such injuries that she soon sank. All of the other ships were more or less injured and were increasing their intervals from the CHEN YUEN and TING YUEN, which, however, kept up the fight unflinchingly.

When the Japanese squadrons reunited, after their combined attack on the main body of the Chinese fleet, they drew out of range, being followed by the Chinese battleships. On renewing the battle the *First Squadron* was sent in pursuit of the fleeing Chinese vessels and succeeded in sinking the KING YUEN. The remaining 5 ships of the *Main Squadron* continued the attack on the 2 battleships, circling around them in column at long distance. During this period of the action the *Matsushima* was struck by a 12-inch shell from the TING YUEN that exploded, causing serious injury to the ship and killing and wounding many men.

At 5.30 p. m. Admiral Ito signaled the *First* to rejoin the *Main Squadron* and closed the action by drawing out of range. The remaining ships of the Chinese squadron returned safely to Port Arthur, where they were repaired and refitted, except the KUANG KIA, which was stranded near the entrance to Talienwan Bay.

The Japanese fleet stood to the southward during the night, in the direction of Weihaiwei, and returned to the scene of the battle on the following morning, when the *Chiyoda* blew up the stranded YUNG WEI. It returned to the rendezvous at Pingyang Inlet on the morning of the 19th. The *Matsushima* (the Admiral having transferred his flag to the *Hashidate* at the close of the battle), *Hiyei*, and *Akagi* were sent to Japan for repairs, while the rest of the ships were refitted at the temporary base and were sent to stations off Shantung Promontory and Port Arthur. They appeared off Chifu and entered the Gulf of Pechili and reconnoitered the coast northeastward of Port Arthur as far as the mouth of the Yalu.

THE PORT ARTHUR CAMPAIGN.

In the meantime an army was preparing in Japan for a campaign having the capture of Port Arthur as its objective. A brigade (Twelfth) of the VI Division (Kumamoto), about 9,000 men, was landed at Chemulpo at the end of September. By October 15th, 37 transports were assembled at Ujina, the port of Hiroshima, on the Inland Sea, used during the war as the base of the army-transport service, for the transportation of the whole of the I Division (Tokyo),

Oct. 15.

JAPANESE SHI

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CHINESE SHIPS:

A TINGYUEN, Flag.

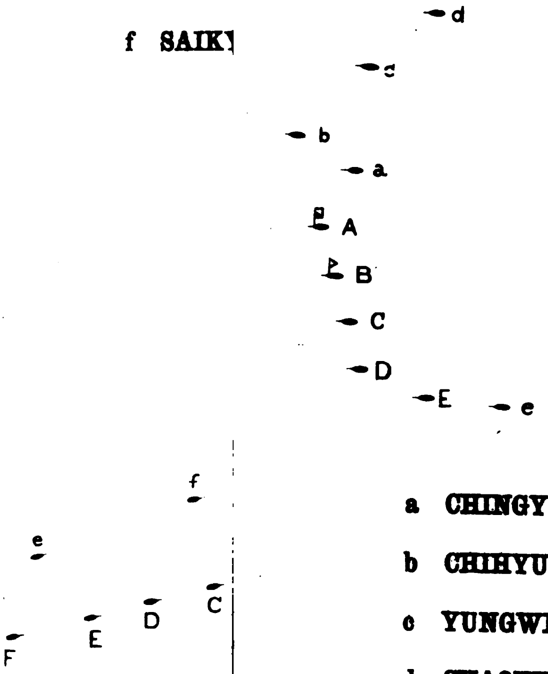
B CHENYUEN, Div. Flag.

C KINGYUEN.

D LAIYUEN.

E TSIYUEN.

F PINGYUEN.



a CHINGYUEN.

b CHIHYUEN.

c YUNGWEI.

d CHAOYUNG.

e KUANGKIA.

f KUANGPING.

JAPANESE SHIPS:

II

A	MATSUS
B	CHIYOD
C	ITSUKUS
D	HASHID
E	FUSO.
F	HIYEI.
a	YOSHIN
b	TAKACH
c	NANIW
d	AKITSU
e	AKAGI.
f	SAIKYO

CHINESE SHIPS:

A	TINGYUEN, Flag.
B	CHENYUEN, Div. Flag.
C	KINGYUEN.
D	LAIYUEN.
E	TSIYUEN.
F	PINGYUEN.
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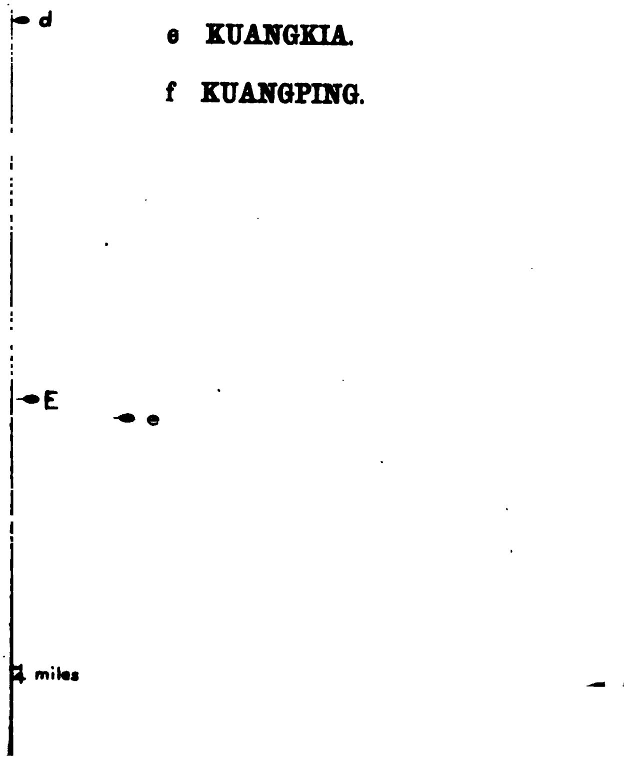
b	CHIHYUEN.
c	YUNGWEI.
d	CHAOYUNG.
e	KUANGKIA.
f	KUANGPING.



III

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A MATS
B CHIYO
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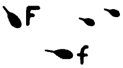

CHINESE SHIPS:

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b TAKACHI
c NANIWA.
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CHINESE SHIPS:

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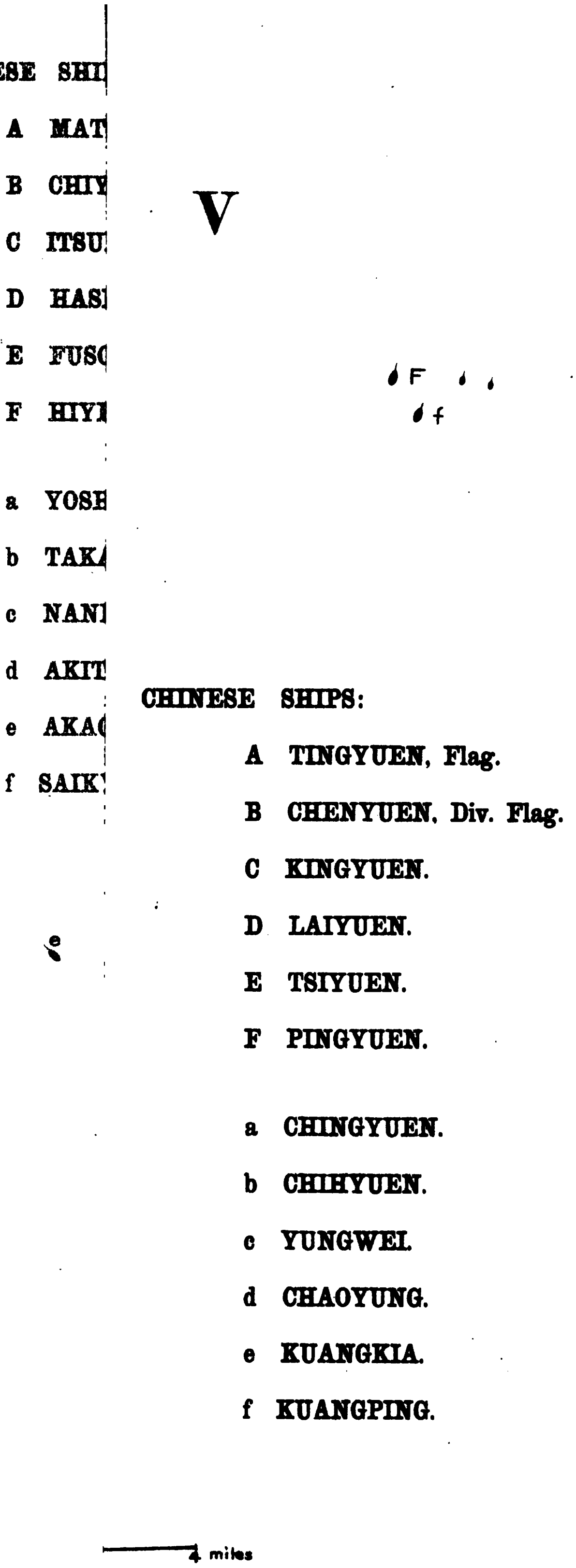
d CHAOYUNG.
e KUANGKIA.
f KUANGPING.



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B CHENYUEN, Div. Flag.

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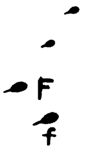

CHINESE SHIPS:

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- d AKITSU
- e AKAGI.
- f SAIKYO

CHINESE SHIPS:

- A TINGYUEN, Flag.
- B CHENYUEN, Div. Flag.
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- D LAIYUEN.
- E TSIYUEN.
- F PINGYUEN.

- a CHINGYUEN.
- b CHIHYUEN.
- c YUNGWEI.
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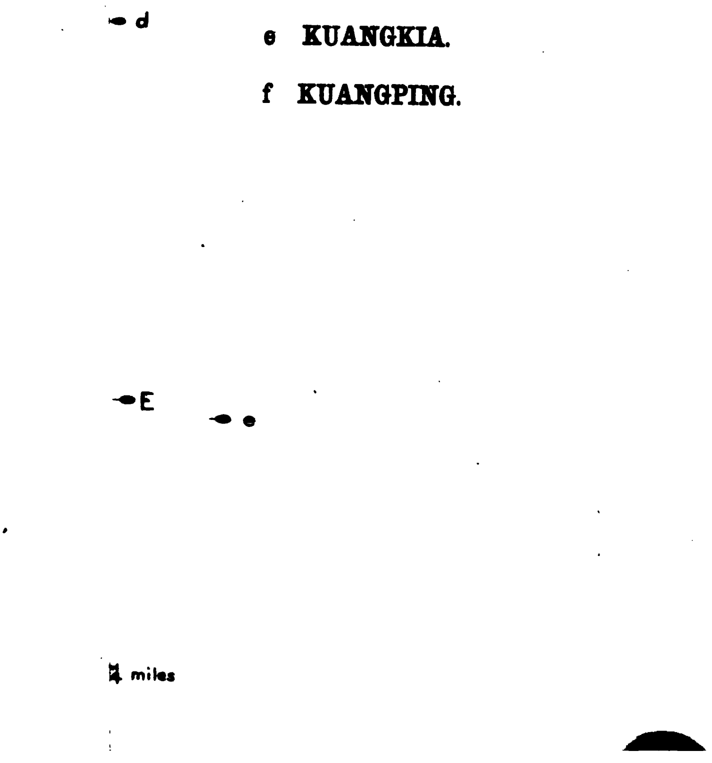
- e KUANGKIA.
- f KUANGPING.



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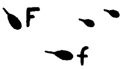

CHINESE SHIPS:

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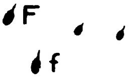

JAPANESE SHIPS:

A MATSUSI
B CHIYODA
C ITSUKUS
D HASHIDA
E FUSO.
F HIYEI.

a YOSHINO
b TAKACHI
c NANIWA.
d AKITSUSI
e AKAGI.
f SAIKYO

CHINESE SHIPS:

A TINGYUEN, Flag.
B CHENYUEN, Div. Flag.
C KINGYUEN.
D LAIYUEN.
E TSIYUEN.
F PINGYUEN.

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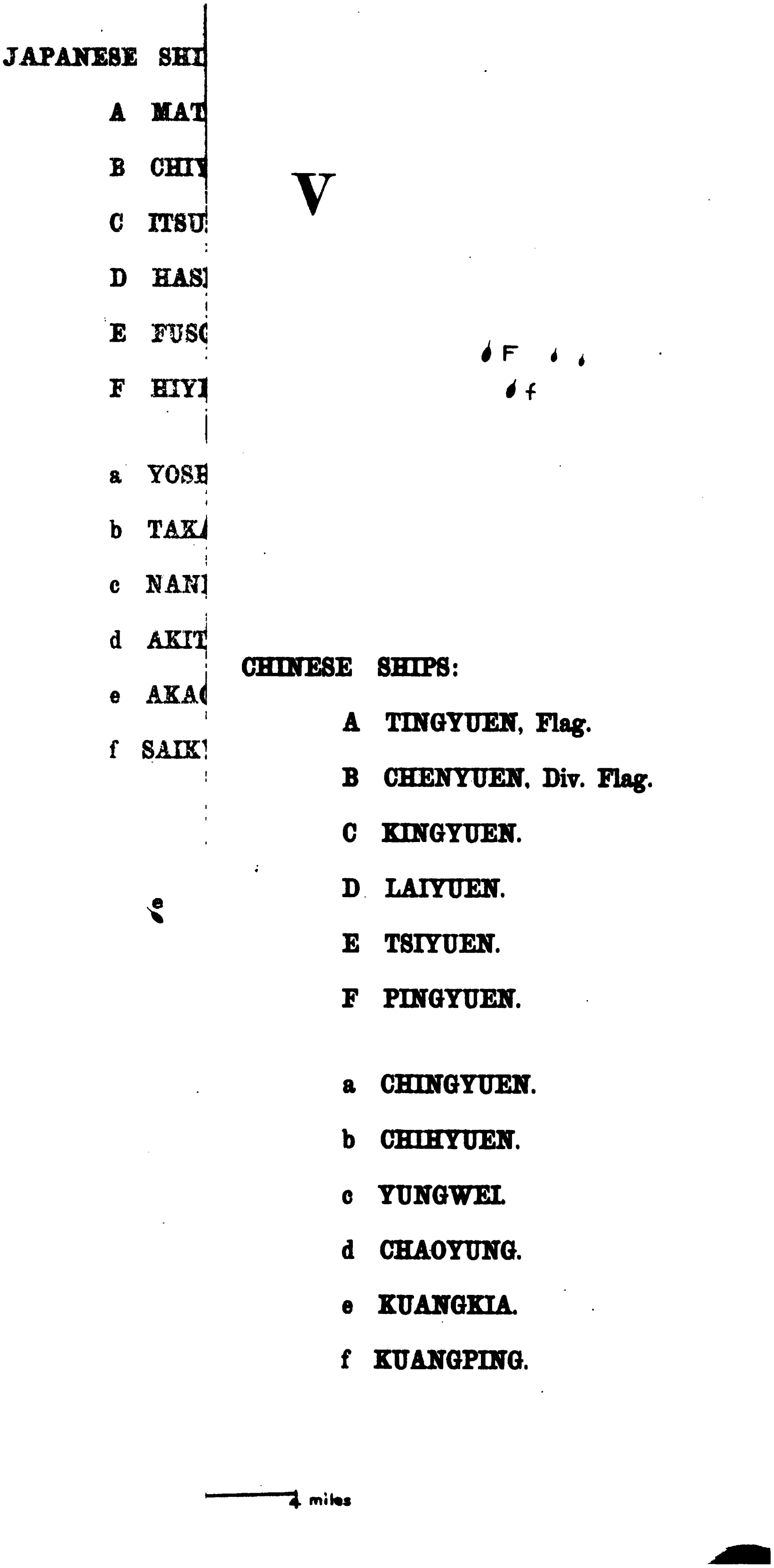
c YUNGWEI.
d CHAOYUNG.
e KUANGKIA.
f KUANGPING.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E TSIYUEN.
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a CHINGYUEN.
b CHIHYUEN.
c YUNGWEI.
d CHAOYUNG.
e KUANGKIA.
f KUANGPING.
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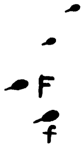
JAPANESE SHIPS

A MATS
B CHIYO
C ITSUK
D HASHI
E FUSO.
F HIYEI.

a YOSHI
b TAKAC
c NANIW
d AKITS
e AKAGI.
f SAIKYO



CHINESE SHIPS:

A TINGYUEN, Flag.
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E TSIYUEN.
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b CHIHYUEN.
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e KUANGKIA.
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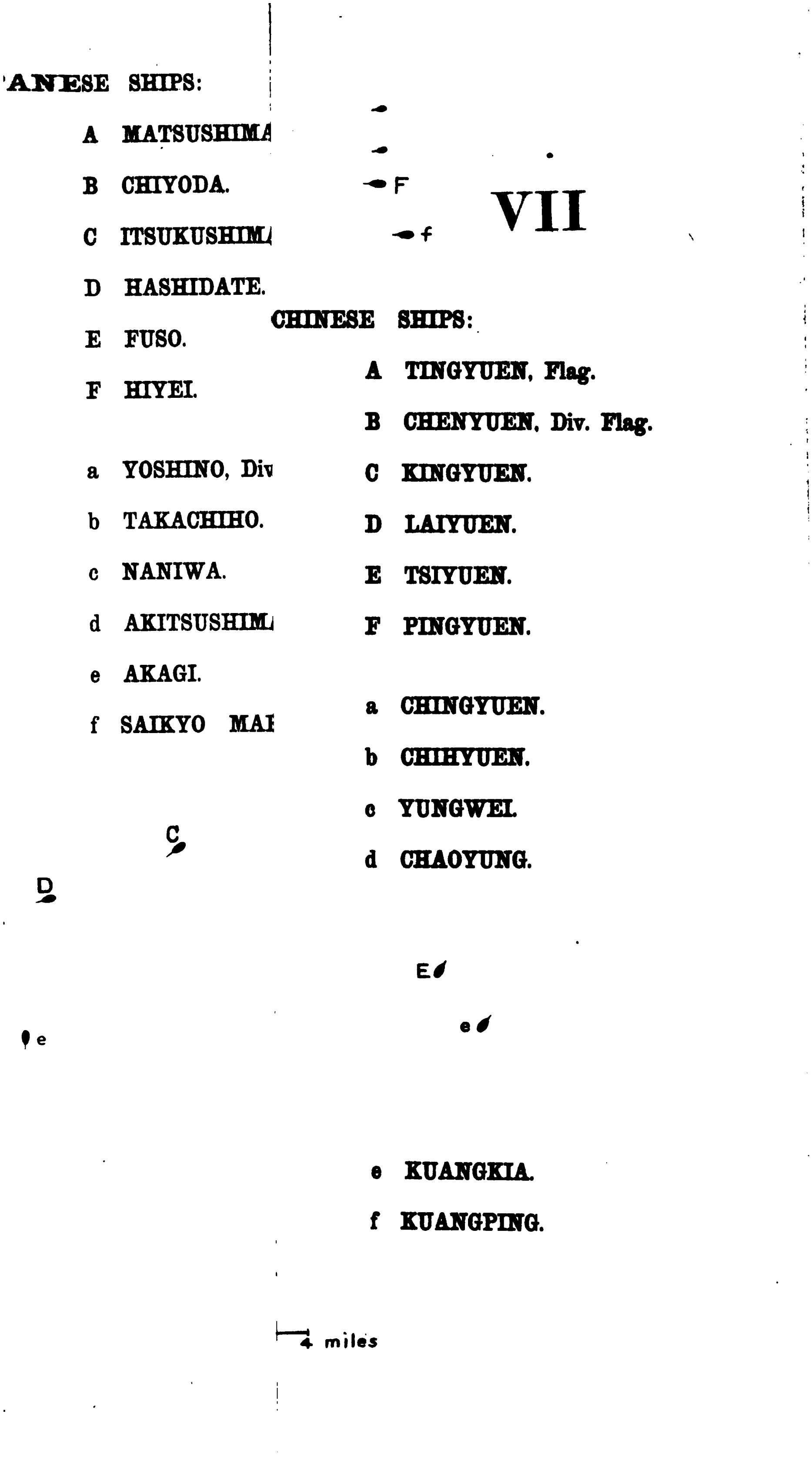
VII


'ANESE SHIPS:
A MATSUSHIMA
B CHIYODA.
C ITSUKUSHIM
D HASHIDATE.
E FUSO.
F HIYEI.
a YOSHINO, Div
b TAKACHIHO.
c NANIWA.
d AKITSUSHIM
e AKAGI.
f SAIKYO MA
CHINESE SHIPS:
A TINGYUEN, Flag.
B CHENYUEN, Div. Flag.
C KINGYUEN.
D LAIYUEN.
E TSIYUEN.
F PINGYUEN.
a CHINGYUEN.
b CHIHYUEN.
c YUNGWEI.
d CHAOYUNG.
e KUANGKIA.
f KUANGPING.
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JAPANESE SHIPS:

A	MATSUSHIMA,
B	CHIYODA.
C	ITSUKUSHIMA.
D	HASHIDATE.
E	FUSO.
F	HIYEI.
a	YOSHINO, Div. F
b	TAKACHIHO.
c	NANIWA.
d	AKITSUSHIMA.
e	AKAGI.
f	SAIKYO MARU.

VIII

ESE SHIPS:

A	TINGYUEN, Flag.
B	CHENYUEN, Div. Flag.
C	KINGYUEN.
D	LAIYUEN.
E	TSIYUEN.
F	PINGYUEN.
a	CHINGYUEN
b	CHIHYUEN.
c	YUNGWEI.
d	CHAOYUNG.
e	KUANGKIA.
f	KUANGPING.

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JAPANESE SHIPS

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C ITSUKU

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F HIYEI.

a YOSHIN

b TAKAC

c NANIW

d AKITSU

SHIPS:

A TINGYUEN, Flag.

B CHENYUEN, Div. Flag.

C KINGYUEN.

D LAIYUEN.

E TSIYUEN.

F PINGYUEN.

e AKAGI.

f SAIKYO

a CHINGYUEN.

b CHIHYUEN.

c YUNGWEI.

d CHAOYUNG.

e KUANGKIA.

f KUANGPING.

JAPANESE SHIPS:

A MATSUSI
B CHIYODA
C ITSUKUSI
D HASHIDA
E FUSO.
F HIYEI.

a YOSHINO
b TAKACHI
c NANIWA
d AKITSUSI
e AKAGI.
f SAIKYO

ESE SHIPS:

A TINGYUEN, Flag.
B CHENYUEN, Div. Flag.
C KINGYUEN.
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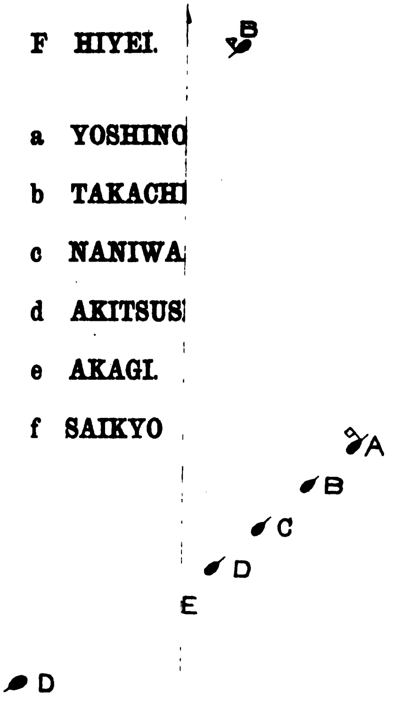

E TSIYUEN.
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a CHINGYUEN.
b CHIHYUEN.
c YUNGWEI.
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about 18,000 men. All of them had sailed on October 18 and were assembled at the rendezvous in Pingyang Inlet on October 22. Under the protection of the Japanese fleet, which was accompanied by 16 torpedo boats, the first division of the transports sailed on the evening of October 23, and the selected landing place, Kwayenko, on a bay about 15 miles northeast of Pitzewo and about 80 miles northeast of Port Arthur, was reached and occupied on October 24 without opposition. The whole of the I Division was landed by October 29, and the brigade of the VI Division, for which transports were sent to Chemulpo, completed its landing by November 4. The fleet covered these operations from its temporary base at the Chang shan Islands (Chang shan tao), a group lying about 15 miles offshore, 70 miles northeastward of Port Arthur, its lookout vessels watching Port Arthur and Weihaiwei.

On the 25th October the town of Pitsewo was occupied and a few days later the advance on Kinchau, about 30 miles northeast of Port Arthur, was begun. This city was taken November 6, after an engagement lasting several hours, principally an artillery duel. The garrison (placed at about 1,500) fled to Talienwan and Port Arthur.

On the morning of November 6, leaving the *Third Squadron* and some special vessels to guard the landing place at the army's base of operations, the rest of the fleet, accompanied by tenders provided with apparatus for searching for mines, left its base and arrived off the entrance to Talienwan Bay at 2 p. m. the same day, torpedo boats reconnoitering off Port Arthur and even drawing the fire of the forts. The tenders at once began the search for mines under the immediate protection of the *Fourth Squadron*. On the morning of the 7th three ships of the *Fourth Squadron* were sent into Talienwan Bay and two into Kerr Bay, northeast of Talienwan Bay and separated from it by a narrow peninsula, where they learned that the forts had been occupied by the army, having been abandoned by the Chinese. The mines covering the entrance were speedily located, a plan of the mine field having been found in one of the captured forts, and on the 9th transports entered the harbor, which now became the base both for the navy and army. On the morning of the 8th the *Yoshino* and *Takachiho* were sent off on lookout duty and in the evening of that day torpedo boats drew the fire of the forts at Port Arthur.

While the Japanese forces were executing the above movements the vessels of the Chinese PEIYANG SQUADRON, whose repairs at Port Arthur had been completed about October 24, were generally in the neighborhood of Port Arthur or Weihaiwei. The squadron left Port Arthur on the evening of November 7, anchored off Taku on the 10th, where it received ammunition and other stores, and went to sea on the 12th. News of its arrival at Weihaiwei having been brought Admiral Ito, he sailed for that port with the *Main*, *First*, and *Second Squadrons*, accompanied by 6 *torpedo boats*, and during the 16th and 17th steamed back and forth across the entrance of the harbor, within which the Chinese fleet could be counted. On the 18th the Admiral returned to Talienwan, leaving the *First Squadron* on watch off Weihaiwei. The CHEN YUEN, returning from a reconnoissance on the 18th, struck a rock off Hwang Island, the little islet near the western end of Liukung Island, which latter closes the center of the mouth of Weihaiwei Harbor, and received such severe injuries that her usefulness was much impaired, even after divers had, with great difficulty, made repairs.

The land operations up to the occupation of Talienwan had been carried on by the I Division alone. On the 13th the mixed brigade, the twelfth, reached Kinchau, and on the 17th the march for Port Arthur was taken up.

Very strongly defended against attack by sea, the defensive works on the land side consisted of a number of redoubts of stone and mud crowning a chain of hills from 2.5 to 3 miles from the navy-yard. These were connected by a Chinese wall, and mounted guns of various calibers, from 12-centimeter Krupp to 1-inch machine guns and gatlings. Ten of these redoubts lay to the eastward and two to the westward of the main road. On the top of a steep ridge and about 1 mile in rear of these works was a line of rifle pits. The Chinese garrison is supposed to have been 13,000, the attacking force 20,000, of whom 15,000 went into action. On the 18th the troop of cavalry leading the advance encountered a large force of Chinese of all arms about 8 miles north of Port Arthur and was driven back, with several wounded. The Japanese advanced to the attack in three columns, having 48 field and mountain and 24 siege guns. On the 20th, the day preceding the general attack, the Chinese made a sortie in force in two columns, threatening the Japanese right. One column was dispersed by a single shell, and the other driven back after some little fighting. On the 21st the general attack was delivered. The right column, after having repulsed a Chinese force of about 1,000, which advanced to meet them, attacked and took the forts west of the main road, where the only real fighting of the day took place. The center and left then moved forward under cover of field and siege gun fire and took the works in their front, meeting with comparatively little resistance. The guns and ammunition were left intact. The retreating Chinese were followed and the line of rifle pits taken, where their outer or uniform clothing was found in great quantities. The fugitives went toward Port Arthur. At 2 p. m. the town was occupied, and here the principal Chinese losses occurred.

Nov. 21.

The same day one of the sea forts was taken, being practically evacuated, and the following day, the 22d, the remaining coast works were found abandoned. Everything, including forts and dockyard, was left in good condition. The Chinese escaped along the shore to the eastward and by junks from a bay west of the city.

The Japanese fleet, with the exception of the *Third Squadron*, which was left at Talienwan, was off the entrance to the harbor of Port Arthur on November 21. The *Fourth Squadron* exchanged a few shots with the eastern forts, but all of the vessels remained out of range of the western forts. Late in the day 2 TORPEDO BOATS were seen coming out of the harbor, and some Japanese *torpedo boats* made a dash at them and destroyed them under fire of the western forts. During the night the *fleet* remained off the port, and on the 22d found the army in possession of the forts. The work of clearing the harbor entrance was speedily begun, and on the afternoon of the 24th a large transport steamer could be taken into the basin.

During these operations a Chinese force of 3,000 or 4,000 men from Fuchau, aided by fugitives from Port Arthur, attacked Kinchau, where a small garrison had been left, but were repulsed. After the capture of Port Arthur, Major-General Nogi was ordered up to hold this place, which afterwards became Marshal Ogama's headquarters, small garrisons being left at Port Arthur and Talienwan.

THE INVASION OF MANCHURIA.

Oct. 24.

On October 24, the same day that the landing place for the operations against Port Arthur was taken possession of, the First Japanese Army commenced the passage of the Yalu, on the right bank of which the Chinese had taken up position and thrown up earthworks. A small column forded the river some miles above Wiju, about 25 miles above the mouth of the Yalu River, and the main body crossed on a pontoon bridge just above the city. The Chinese were attacked October 25 nearly opposite Wiju and defeated, part retreating northwest toward Kiuliencheng and others southwest toward Antong. The former place was occupied the following day without opposition, having been evacuated. The Chinese strength in this engagement is variously estimated, but probably did not exceed 23,000. Considerable war material was captured by the Japanese.

The Chinese lines of retreat were toward Fenghuangcheng, on the main road to Moukden, and through Antong, along the southern road, to Takushan, about 30 miles west of the mouth of the Yalu River. They were pursued on both routes and appear to have been demoralized, abandoning a number of field pieces and a quantity of military stores. Major-General Tatsumi's brigade entered Fenghuangcheng on the 31st October, meeting with no opposition. Here again the Chinese seem to have divided, taking the roads north to Moukden and northwest to Haicheng. Hearing that they had assembled in considerable force at Siuyen on the road north from Takushan, Field Marshal Yamagata directed Major-General Oseka, who had pursued as far as Takushan, to march against them. Siuyen was reached November 18, no resistance being met with at that place, the Chinese retreating to Sumucheng, southeast of Haicheng, where the roads from Siuyen to Haicheng and Fenghuangcheng to Inku cross. Both brigades of the III

Division, Lieutenant-General Katsura commanding, joined in an attack on the Chinese near Sumucheng, and drove them toward Haicheng, a place of considerable strategic value. The Japanese advance was slow, the difficulties of transport being very considerable, and having to keep up communication with the V Division, operating on the Kiulien-cheng-Fenghuangcheng road. Haicheng was occupied December 13, and here the Japanese proceeded to intrench and accumulate supplies.

Dec. 13.

In the meanwhile, the V Division was having considerable fighting north of Fenghuangcheng, where Major-General Tatsumi was pushing north toward Liaoyang, and on the roads east of Fenghuangcheng, where the Chinese made several attempts to cut their communication with Kiulienchenng. The Japanese advance guard on the northern road received a check at Motien Pass (Motien ling), on the road from Fenghuangcheng to Moukden, but probably no determined effort was made to force this pass. The Chinese General I, who is said to have directed the Chinese movements in the vicinity of Fenghuangcheng, appears to have realized the importance of cutting his enemy off from his base at the Yalu, but his efforts were unsuccessful.

Several days after the occupation of Haicheng by the Japanese, General Katsura, finding the enemy in force about 10 miles west of that place, sent a force of 1,500 or 2,000 men against them. The Chinese, in greatly superior numbers, made a stubborn resistance, and were only compelled to retreat, after several hours' fighting, by the arrival of Japanese reenforcements. Here the lines of retreat appear to have been toward Niuchwang and its port, Inku. The losses on both sides were considerable. The position at Haicheng, with the Chinese in greatly superior numbers on the left and front, was evidently not considered sufficiently secure, and about the end of the year Major-General Nogi was sent north from Kinchau with a brigade of the I Division, Second Army (which had been engaged in the Port Arthur campaign), and reached Kaiping (Kaichow) January 10, driving out the Chinese with considerable loss. This put him within supporting distance of the III Division at Haicheng, with which he opened communication. The remaining brigade of the I Division afterwards followed, uniting this division at Kaiping under its commander, Lieutenant-General Yamagi.

The Japanese then, January 10, held Kaiping, Haicheng, and Fenghuangcheng in force, keeping open communication with Takushan via Siuyen, and with Kiulienchenng and Antong. The headquarters of the First Army were at Kiulien-cheng, while Marshal Yamagata commanded, and at Antong, when, about December 10, he was succeeded by General Nodzu.

Jan. 10, 1895.

While the invading forces occupied this position, which remained practically unchanged until the latter part of February, the Chinese confronted them in vastly superior numbers. There appear to have been three corps or divisions, with headquarters at Liaoyang, Niuchwang, and Tienchwangtai, the latter force holding Inku, the port of Niuchwang. They made several ineffectual attempts to recapture Haicheng on January 17 and 22 and February 16, 18, and 21, and Sumucheng February 18. The Japanese losses were comparatively light.

THE WEIHAIWEI CAMPAIGN.

During the interval between the fall of Port Arthur and until the Third Army was ready for its campaign, the Japanese fleet continually kept Weihaiwei under observation, and frequently reconnoitered Chifu and places on the Gulf of Pechili, drawing coal from the coal pile captured at Port Arthur. At the same time the work of refitting the ships was pushed, the resources of the navy-yard (left uninjured by the Chinese) at Port Arthur being available to the Japanese, so that the whole fleet was prepared to take part in the reduction of Weihaiwei.

The army assembled for the capture of Weihaiwei consisted of the II Division (Sendai) and one brigade (eleventh) of the VI Division (Kumamoto), having an effective strength of 19,000 men, its rationed strength being about 36,000. These troops were sent from Ujina in detachments, at various times, and were all assembled on fifty transports in Talienwan Bay by January 19. On January 18 the *Yoshino*, *Akitsushima*, and *Takachiho* made a demonstration before Tengchaufu, on the south side of the entrance to the Gulf of Pechili, about 70 miles westward of Weihaiwei, which they repeated on the 19th, and then rejoined the rest of the fleet, which had sailed from Talienwan Bay on the evening of January 19, convoying the first detachment of 19 transports to the landing place in Yungching Bay, just under Shantung Promontory. The landing commenced on the morning of January 20; and after the advance guard was firmly established in the possession of the landing place, the fleet took position off Weihaiwei watching the Chinese fleet. The rest of the transports sailed in two detachments, one on the 20th, the second on the 22d, and all the troops were landed by the 23d, though it took several days longer to land the impedimenta.

The harbor of Weihaiwei was defended against attack from the sea by strong earthworks on the mainland and islands, whose heavy guns commanded both entrances. The eastern group on the mainland had for defense on the land side simply a clay wall from 3 to 5 feet thick, and a slight earthwork mounting field guns, from which the heavy works on the sea front could be taken in reverse. To the westward the land defense consisted of a sand-bag parapet of double thickness mounting a number of guns of from 10.5 centimeters (4.1 inches) to field-gun caliber, and one Nordenfeldt machine gun. Land mines were laid in the approaches. On the island of Liukung were mounted in barbette, some on disappearing carriages, a number of guns from field-gun caliber up to 9.45 inches. On Zhih or Channel Island, a small island in the eastern entrance south of the east end of Liukung, was a well-built fort having two 8-inch guns on disappearing mounts and some of smaller caliber.

Several hundred Chinese with field guns offered some resistance to landing, but were driven off by the fire of one of the ships.

On January 20 the advance guard occupied the town of Yungching, and on January 25 the forward movement began in two columns, the II Division taking the southern road and having daily skirmishes with a retreating body of Chinese, and the eleventh brigade along the northern or coast road. These roads were mere trails, and on the 30th, when the attack began, the field pieces had not come up. About 9 a. m. on the 30th the eastern works were assaulted and by 12.40 were in the hands of the Japanese.

Jan. 30.

During these operations, the fleet, though in position off the entrance, took little active part in the reduction of the forts, the smaller vessels only making a demonstration. But a party of officers and men from the fleet occupied one of the captured forts at the eastern entrance and opened fire on the fort on Zhih or Channel Island, which was replied to by that fort, the two eastern forts on Liukung Island, and by the Chinese fleet. While the Chinese were fleeing from the eastern forts, the Japanese deployed one battalion across the open beach, facing to the westward, and while firing at the fleeing Chinese this line was enfiladed by the fire from several of the latter's vessels with heavy loss, the battalion being dispersed.

February 1 the Japanese southern column took position across the western promontory. The battalion on the left of this line encountered the Chinese fleeing from the western forts early on February 2 and sustained considerable loss. Being reenforced they drove off the Chinese, who retreated to Chifu.

Weihaiwei was occupied the same day without resistance, the western forts having been abandoned.

A violent snowstorm, lasting from January 31 to February 2, drove the Japanese fleet to shelter, the *First Squadron* remaining to keep watch at the entrances of the harbor.

The fleet returned to its station on February 3 and resumed the occasional bombardment of the island forts. The booms across the entrances of the harbor were examined as occasion offered, and at the east boom a channel practicable for torpedo boats was found between its southern end and the shoal making off from Camp Point on the south side of the eastern entrance. At 2 a. m. February 5th, 10 *torpedo boats* left their anchorage under Three Peaked Point, a few miles to the eastward of the eastern entrance, to enter the harbor through this gap. Eight of them succeeded in doing so and made an attack on the Chinese fleet, discharging 11 torpedoes, of which 1, from *No. 9*, struck the TING YUEN. *No. 9* received a shot through her boiler and had to be temporarily abandoned, and *No. 22* ran aground in attempting to leave the harbor and was lost; the other boats returned safely. The TING YUEN, after being torpedoed, was run into shoal water, where she sank. A few days later she was practically destroyed by the Chinese by dynamite exploded in her engine room.

Early in the morning of February 6 a second attack was made by *torpedo boats*. Five boats started; 4 entered the harbor and discharged 7 torpedoes, sinking the LAI YUEN, WEI YUEN, and the tender PAUFAH. All the torpedo boats returned safely.

The eastern forts, manned by the Japanese, and some of the Japanese vessels exchanged shots with the Chinese fleet and island forts at intervals after January 30. On February 7 a magazine on Channel Island exploded and the fort was abandoned soon afterwards. While this action was going on the Chinese TORPEDO-BOAT FLOTILLA left the harbor through the western entrance and was chased by the *First Squadron;* all the boats were either captured or destroyed.

February 9 the Japanese mounted batteries of 9 centimeters (3.54 inches) bronze mortars near the western group of forts and opened on the batteries on Liukung Island. The eastern forts also exchanged shots with the island and the Chinese fleet, the firing continuing at intervals throughout the day, the Chinese protected cruiser CHING YUEN being sunk. On the 11th the Japanese *fleet* again opened fire on the island forts, but the high wind and heavy sea soon compelled the ships to draw off. During the whole campaign for the possession of Weihaiwei the weather was frequently foul, so that the operations of the fleet were interrupted or could be carried on only under the greatest difficulty.

Feb. 17.

On February 12 negotiations for surrender were begun by a communication from Admiral Ting to Admiral Ito, and on February 17 the Japanese *fleet* entered the harbor through the western entrance, taking possession of the island forts and the remaining ships of the Chinese squadron. The body of Admiral Ting, who had committed suicide, and the officers who had surrendered were sent to Chifu in the KANGCHI, one of the captured vessels, supplied by the Japanese for the purpose; the men were landed on the mainland. The ships captured were the CHEN YUEN, TSI YUEN, PING YUEN, KUANG PING, and 6 of the ALPHABETICAL GUNBOATS. The CHEN YUEN was sent to Port Arthur for temporary repairs, the others direct to Japan. The forts on the mainland were blown up and the guns destroyed, and by the end of February the army was withdrawn to Talienwan, except a detail of 8 companies of 40 men each, which, under the navy, remained to garrison Liukung Island.

THE SPRING CAMPAIGN IN MANCHURIA.

Feb. 24.

Returning to the movements of the invading forces in Manchuria, Lieutenant-General Yamagi, commanding the I Division, Second Army, having arrived at Kaiping, and Nodzu at Haicheng with part of the V Division, hitherto at Fenghuangcheng and vicinity, an advance was determined on. On February 24 troops were pushed out from Kaiping, and Tapingshan, a small town about 10 miles southeast of Inku, was taken after some severe fighting. Several days later General Katsura moved out from Haicheng with part of his force, and taking the Liaoyang road pushed back the Chinese forces some 13 or 14 miles, then turned toward Niuchwang and, assisted by a direct attack from Haicheng by part of the V Division, captured **Mar. 4.** that place March 4, after fighting lasting from 10 a. m. to 11 p. m., much of which was house to house fighting. Here also the victors secured quantities of military stores. Lieutenant-General Yamagi then advanced against Inku, the port of Niuchwang, **Mar. 7.** which he occupied March 7, the Chinese retreating across the frozen river to Tienchwangtai. The Japanese held Inku ready to open communication with the fleet so soon as the ice should permit. An abandoned Chinese vessel, the MEI YUEN, was **Mar. 9.** captured here. On March 9 troops of the First Army, assisted by a brigade of the Second Army, attacked the Chinese at Tienchwangtai, on the west bank of the Liao River, and captured the place after several hours' fight. The main body of the Chinese are believed to have retreated from this place before the attack, and the principal resistance met with was in the streets, similar to that at Niuchwang. On the 18th of March Lieutenant-General Nodzu was promoted to be field marshal.

THE PESCADORES, FORMOSA, AND THE CLOSE OF THE WAR.

After the capture of Weihaiwei, the *Main* and *First Squadrons* (*Chiyoda* excepted), 7 ships having large coal endurance, Admiral Ito remaining in command, were ordered to Japan to refit and prepare for operations off the coast of Formosa. The remaining vessels of the *fleet*, 12 to 15 in number, under Admiral Inouye, with the *Fuso* as flagship, continued operations in the Gulf of Pechili. This *Northern Squadron* appeared off Taku at the mouth of the Peiho about March 19 and overhauled vessels trading with Tientsin and carefully reconnoitered the coast in that neighborhood. The armistice on March 30 closed its active operations.

Admiral Ito's squadron of 7 ships, accompanied by 5 transports, in which was embarked 3 battalions (about 2,800 men) and a battery of mountain guns, came to anchor off Rover Island (Pachan), the southernmost of the Pescadores Group, on March 20, and 2 cruisers were sent forward to reconnoiter Fisher and Ponghau islands. Admiral Ito determined to effect the landing on the eastern end of Ponghau, but bad weather delayed the beginning of the operations until the morning of the 23d. Then the troops disembarked at the place selected, four of the men-of-war covering the landing place, while three of them engaged a small fort on the south side of the island about 4 miles to the westward and a larger fort nearer Makung. The troops being firmly established, three of the covering ships were sent to join in the attack on the forts, the smaller of which was abandoned by the Chinese about 2 p. m.

On the morning of the 24th the troops advanced against Makung, the principal town of the group, on the west side of Ponghau, and after offering some slight resistance the Chinese abandoned their works, disabling the guns by carrying off movable parts, and crossed over to Fisher Island in junks. After the Japanese flag was hoisted over Makung, at 11.30 a. m., the Chinese forts on Fisher Island opened fire, which was continued until the following morning. Accompanying the Japanese column was Lieutenant Inouye, I. N., with 30 men from the fleet. He was able to get one of the guns of the captured fort into working order and fired several shots at the Fisher Island forts on the 25th. Not receiving a reply, he crossed with his men in a fishing boat that night to Fisher Island and found that the Chinese had abandoned the forts and escaped to the mainland in junks. When the fleet arrived off the south shore of the island on the morning of the 26th it found the Japanese flag flying and Lieutenant Inouye in possession. After searching the channel between the two islands for mines, the fleet entered and anchored off Makung; but when cholera broke out among the troops it moved out of the harbor. **Mar. 24.**

Its next important operation was to cover the landing of the Japanese imperial guards at Kelung, Formosa, sent there near the end of May as an army of occupation.

By the terms of the armistice, which took effect March 30, active operations in the districts of Moukden, Chili, and Shantung only were suspended. At this time the Japanese forces which had been engaged in the capture of Port Arthur and Weihaiwei were at Talienwan and Kinchau, except one division which had advanced north into Manchuria to support the First Army. This combined force held the line from Tienchwangtai, on the right bank of the Liao River, southeast to the mouth of the Yalu River, with probably no considerable Chinese force south of it. Additional troops were being mobilized in Japan. The Chinese are believed to have been in force at Kirin, at Moukden and vicinity, at Shanhaikwan (the end of the Great Wall), at Taku and Tientsin, and in great numbers in and about Pekin, which city it was expected would be the next objective point. The Japanese fleet, without an adversary, had full command of the sea, the Northern Squadron operating in the Gulf of Pechili, and the Southern Squadron in possession of the Pescadores, in readiness to assist the force intended for the occupation of Formosa. **Mar. 30.**

The treaty of peace was signed by the plenipotentiaries of the two powers on April 17, 1895, and the ratifications by the Emperors of Japan and China were exchanged on May 8. It provided for the recognition of the full and complete independence of Korea; the cession by China to Japan of Formosa and the Pescadores; the payment of a war indemnity of 200,000,000 taels; the opening to trade of several Chinese cities heretofore closed; the extension to Japanese steam navigation of several rivers in China, and **April 17.** **May 8.**

the security of certain rights to Japanese subjects in China; Japan to evacuate Chinese territory within three months, but to occupy Weihaiwei temporarily, at the partial expense of China, as a guaranty of the faithful performance of the stipulations of the treaty; prisoners of war to be exchanged, and Chinese prisoners of war and Chinese subjects who may have been compromised in their relations with the Japanese army not to be punished. One article of the treaty gave Japan possession of the southern part of the Province of Feng-Tien, including Port Arthur, but by an imperial rescript, dated June 10, 1895, the Japanese Government expressed the intention of leaving this territory under Chinese jurisdiction in these words:

> Since, then, the Governments of their majesties the Emperors of Russia and Germany and of the Republic of France have united in a recommendation to our Government not to permanently possess the peninsula of Feng-Tien, our newly acquired territory, on the ground that such permanent possession would be detrimental to the lasting peace of the Orient.
>
> Devoted as we unalterably are and ever have been to the principles of peace, we were constrained to take up arms against China for no other reason than our desire to secure for the Orient an enduring peace.
>
> Now, the friendly recommendation of the three Powers was equally prompted by the same desire. Consulting, therefore, the best interests of peace, and animated by a desire not to bring upon our people added hardship or to impede the progress of national destiny by creating new complications and thereby making the situation difficult and retarding the restoration of peace, we do not hesitate to accept such recommendation.

June 2.

The formal transfer of Formosa and the Pescadores from China to Japan was completed on June 2 at Kelung, Formosa, by the exchange of the proper documents between the Chinese commissioner and Admiral Kabayama, the newly appointed Japanese governor-general.

IX.

SOME STANDARD BOOKS ON PROFESSIONAL SUBJECTS.

Officers and others are requested to inform the Office of Naval Intelligence of any standard works on professional subjects, of recent date, which are not mentioned in the following list:

Foreign books, newspapers, and periodicals may be obtained from B. F. Stevens, 4 Trafalgar Square, Charing Cross, London. From B. F. Stevens' advertising circular "new books are charged at trade prices, which are usually 25 per cent off the price of publication. Book postage to America is only one-half penny for every 2 ounces up to 4 pounds weight."

"The discount off publication price is about equivalent to the cost of freight or postage, and commission; hence, in making purchases of new books it is safe to estimate that the books would be received at a cost of 25 cents to the shilling (publication price), exclusive of duty, if any."

Remittances to B. F. Stevens, 4 Trafalgar Square, Charing Cross, London, may be made in sterling by banker's drafts, or post-office orders on London, or in American currency at $5 to the pound sterling, this being 25 cents to the shilling. For odd amounts send postage stamps. New York agents, Tice & Lynch, 45 William street.

This list of books has been arranged in accordance with the plan of, and should be considered as supplementary to, the one issued by the Bureau of Equipment for ships' libraries.

GENERAL WORKS.

ADMIRALTY, BRITISH:

FLAGS IN USE AT THE PRESENT TIME BY VARIOUS NATIONS, DRAWINGS OF. 1890. Admiralty. Price, 50s. To be obtained from J. D. Potter, 31 Poultry; Eyre & Spottiswoode, East Harding street, Fleet street, London, or Hodges, Figgis & Co., 104 Grafton street, Dublin.

BERGER-LEVRAULT:

CARNET DE L'OFFICER DE MARINE. Annual. 1895. Fifteenth year. Vol. in-8 relié, 3 francs 50 centimes. Berger-Levrault et C^{ie}., 5 rue des Beaux-Arts, Paris.

DABOVICH:

NAUTISCH-TECHNISCHES WÖRTERBUCH DER MARINE. Deutsch, Italienisch, Französisch und Englisch. 1883. By P. E. Dabovich, K. K. Marine-Bibliotheksadjunct. Pola: Redaction der Mittheilungen aus dem Gebiete des Seewesens. It can be purchased, London, Dulau & Co., W., 37 Soho Square; Paris, Challamel aîné, 5 rue Jacob; Wien, Gerold & Co.; Triest, Juliu Dase; Torino, Ermanno Loescher. Erster Band: Deutsch, Italienisch, Französisch und Englisch. Italienisch, Deutsch, Französisch und Englisch. But one volume published whose argument is either Italian or German.

DELBOS:

TERMES DE MARINE ANGLAIS-FRANÇAIS. 1890. Par Léon Delbos, professeur à l'École navale anglaise. Prix, 4 francs. Paris: Publié par L. Baudoin et C^{ie}, 30 rue Dauphine. Deuxième édition. 1 vol. in-12°, relié. Notes et tableaux à l'usage des officiers de la flotte et des élèves des écoles navales.

FITZ GERALD:

THE YEAR BOOK OF THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA. 1895. A statistical record of the resources and trade of the Colonial and Indian Possessions of the British Empire. Compiled chiefly from official sources. Published at the offices of the Imperial Institute, South Kensington, S. W.

GEROLD:

ALMANACH FÜR DIE K. U. K. KRIEGS-MARINE. 1895. Herausgegeben von der Redaction der Mittheilungen aus dem Gebiete des Seewesens. Wien, Gerold & Co., in Comm. Geb., 4 marks. An annual.

JONES:

SHIPPING WORLD YEAR BOOK: A DESK MANUAL IN TRADE, COMMERCE, AND NAVIGATION. 1894. Edited by Evan Rowland Jones, United States Consul. Price, 3s. 6d. London: Printed and published annually at the Shipping World Office, Gresham Press Buildings, Pilgrim street.

MULHAL:

DICTIONARY OF STATISTICS. Routledge & Sons, 9 Lafayette place, New York. 1895.

MÜLLER-SAGAN:

DISLOKATIONSKARTE DER HEERE EUROPAS. In four parts. 1895.

PORNAIN:

TERMES NAUTIQUES, ANGLAIS-FRANÇAIS. Augustin Challamel, 5 rue Jacob, Paris.

VIVANT:

DICTIONNAIRE TECHNIQUE, ANGLAIS-FRANÇAIS. 1884. Par E. Vivant, mécanicien en chef de la marine. Prix, 12 francs. Paris: Publié avec l'autorisation du ministre de la marine. 1 fort vol. in-8.

WHITAKER:

ALMANACK, 1895. Containing an account of the astronomical and other phenomena, a large amount of information respecting the Government, finances, population, commerce, and general statistics of the British Empire throughout the world, with some notice of other countries.

NAVAL AND MILITARY ARTS.

ABBOT:

PROFESSIONAL PAPERS OF THE CORPS OF ENGINEERS, UNITED STATES ARMY, NO. 23. Report upon experiments and investigations to develop a system of submarine mines for defending the harbors of the United States. 1881. Submitted to the Board of Engineers by Lieut. Col. Henry L. Abbot, Corps of Engineers, brevet brigadier-general United States Army, member of the Board. Washington: Government Printing Office.

BARBER:

HIGH EXPLOSIVES IN WARFARE. 1891. By Commander F. M. Barber, United States Navy. Published in the Journal of the Franklin Institute, Vol. CXXXI, No. 782, February, 1891, No. 2, pages 117 *et seq.*, Philadelphia. Dr. William H. Wahl, secretary.

BAUDOIN:

MANUEL DU MARIN CANONNIER. 13^{me} ed. L. Baudoin et C^{ie}., 30 rue et passage Dauphine.

BETHELL:

REMARKS ON THE MANŒUVRES OF TWO VESSELS IN ACTION. 1881. By Lieut. G. R. Bethell, R. N. Price, 2s. Portsmouth: Griffin & Co., No. 2 The Hard. London agents: Simpkin, Marshall & Co.

BOADO Y CASTRO:

LOS FUSILES MAUSER ADOPTADOS EN EUROPA Y EN AMERICA. By D. José Boado y Castro, capitan de artilleriá de la fabrica nacional de armas de Oviedo. 1894. Pardo, Gusano y Compañía, San José, 6. 1 peseta. 7.65 mm. Mauser, 1890–91 models. Full description of each part.

BOURGOIS:

LES TORPILLEURS, LA GUERRE NAVALE ET LA DÉFENSE DES CÔTES. 1888. Par le Vice-Amiral Bourgois. Paris, Librairie de la Nouvelle Revue, 18 Boulevard Montmartre. Deuxième édition.

BOUTAKOF:

NOUVELLES BASES DE TACTIQUE NAVALE. Par l'Amiral Grégoire Boutakof. Traduit du russe par H. de la Planche, lieutenant de vaisseau. Paris: Arthus Bertrand, éditeur, Librairie Maritime et Scientifique, rue Hautefeuille, 21. Ouvrage couronné par l'Académie des Sciences de St.-Pétersbourg, publié par ordre de S. Exc. le Marquis de Chasseloup-Laubat, Ministre de la Marine et des Colonies. Accompagné de 26 planches gravées, dont 15 en couleur, et de nombreuses figures intercalées dans le texte.

BUCHARD:

TORPILLES ET TORPILLEURS DES NATIONS ÉTRANGÈRES, SUIVI D'UN ATLAS DE FLOTTES CUIRASSÉES ÉTRANGÈRES. 1889. Par H. Buchard, lieutenant de vaisseau. Prix, 6 francs. Paris, Berger-Levrault et C^{ie}, 5 rue des Beaux-Arts. Vol. in-8, avec 114 planches, broché.

CAMPBELL:

ESSAY ON TACTICS IN AN ACTION ON THE OPEN SEA WITH EXISTING WEAPONS. By Lieut. Campbell, R. N. Price, 2s. London: Harrison & Sons, 59 Pall Mall S. W. 8vo. Sewn.

CHALON:

TRAITÉ THÉORIQUE ET PRATIQUE DES EXPLOSIFS MODERNES ET DICTIONNAIRE DES POUDRES ET EXPLOSIFS. 1889. By Paul F. Chalon, ingénieur des arts et manufactures. Price, 25 francs. Publishers, E. Bernard et C^{ie}, 71 rue La Condamine; 53, Quai des Grands-Augustins. 1 vol. in-8 de 506 pp., avec 162 fig. dans le texte. Seconde édition.

CHARMES:

LES TORPILLEURS AUTONOMES ET L'AVENIR DE LA MARINE. 1885. Par Gabriel Charmes. Prix, 3 francs. Paris: Berger-Levrault et C^{ie}, 5 rue des Beaux-Arts. Vol. in-12, broché.

CHEVALIER:

LES INSTITUTIONS DE LA MARINE.

Clergeay:

Guide Pratique du Chauffeur et du Mécanicien sur les Bateaux Torpilleurs, rédigé en conformité de la dépêche ministérielle du 15 janvier 1887, par M. E. Clergeay, mécanicien en chef de la marine. Dessins du 2^e maître-mécanicien, C. Deguy, Paris, 1888. Un beau vol., in-8, relié. Price, 5 francs 50 centimes.

Clowes:

The Newest Factor in Naval Warfare. 1891. By W. Laird Clowes. Price, 1s. Published in the United Service Magazine for February, 1891. To be obtained from the International News Company, New York.

Cournès:

Aperçus sur la Tactique de Demain mis en Rapport avec la Puissance du Nouvel Armement et l'Lemploi de la Poudre sans Fumée. Commandant Cournès. Paris: Baudoin.

Craig:

Azimuth—A Treatise on this Subject. 1877. By Joseph Edgar Craig, Lieutenant-Commander, United States Navy. New York: John Wiley & Sons, 51 Astor Place. A study of the astronomical triangle and the effect of errors in the data. Illustrated by loci of maximum and minimum errors.

Croneau:

Construction du Navire. Par A. Croneau, ingénieur des constructions navales. Paris: Gauthier-Villars et fils, Quai des Grands-Augustins, 55.

Canons, Torpilles et Cuirasses. Par A. Croneau, ingénieur des constructions navales. Leur installation à bord des bâtiments de combat. Paris, Gauthier-Villars et fils, Quai des Grands-Augustins, 55.

Architecture Navale: Construction pratique des navires de guerre, 1894. 2 vols. and atlas.

Cundill:

A Dictionary of Explosives. 1889. By Maj. J. P. Cundill, Royal Artillery. Printed by W. & J. Mackay & Co., Chatham. Published by the Royal Engineers' Institute, Chatham. Agents, W. & J. Mackay & Co., Chatham, Kent. Also sold by Hamilton, Adams & Co., London.

Didelot:

La Défense des Côtes d'Europe. Étude descriptive au double point de vue militaire et marine, 1894. Avec un atlas de 204 cartes. Par Carl Didelot, lieutenant de vaisseau. Berger-Levrault et C^{ie}, 5 rue des Beaux-Arts.

Dredge:

Modern French Artillery: (The St. Chamond, De Bange, Canet, and Hotchkiss Systems.) 1892. By James Dredge. Price, £2 10s. London: Offices of Engineering, 35 and 36 Bedford street, Strand, W. C. New York: John Wiley & Sons, 53 East Tenth street. Imperial quarto, handsomely bound in half morocco, 500 pages of text, tables, and plates, and over 700 illustrations. The work is provided with a carefully prepared and copious index, and also contains many illustrations of French war ships.

Eardley-Wilmot:

The Development of Navies. 1892.

Elliot:

The Ram. The Prominent Feature of Future Naval Victories. 1884. By George Elliot. Price, 5s. London: Published by the Journal of the Royal United Service Institution.

Coast Defense by Gunboats. 1887. By George Elliot. Price, 7s. 21 pp., 8vo, with 1 plate and 7 figures. Published by the Journal of the Royal United Service Institution.

FARRET:

ÉTUDES COMPARATIVES DE TACTIQUE NAVALE. 1883. Par M. Étienne Farret, lieutenant de vaisseau. Prix, 3 francs. Paris: Berger-Levrault et C^{ie}.

GAVOTTI:

MANUALE DEL TIMONIERE. Compilato per ordine del Ministro della Marina da Francesco Gavotti, capitano di corvetta. 1889. Roma, Forzani, Tipografia del Senato.

GOUGEARD:

LA MARINE DE LA GUERRE. SON PASSÉ ET SON AVENIR. CUIRASSES ET TORPILLEURS. 1885. Par M. Gougeard, ancien ministre de la marine. Prix, 3 francs. Paris, Berger-Levrault et C^{ie}. Grand in-8, avec 1 planche, broché.

GUYON:

DESCRIPTION ET USAGE DES INSTRUMENTS NAUTIQUES. Ministère de la Marine. 1889. Par M. E. Guyon, capitaine de frégate, chef du service des instruments nautiques au service hydrographique de la marine. Paris: Imprimerie Nationale.

GWYNNE:

HINTS ON ANCHORING AND MOORING WITH THE FLEET. By Staff Commander B. Gwynne. Price, 1s.

HEBLER:

DAS KLEINSTE KALIBER. By Professor Hebler. Zürich: A. Müller.

HOVGAARD:

SUBMARINE BOATS. 1887. By G. W. Hovgaard, lieutenant in the Danish navy. E. & F. N. Spon, 125 Strand, London, and 35 Murray street, New York.

LANESSAU:

LA MARINE FRANÇAISE AU PRINTEMPS DE 1890.

LEDIEU ET CADIAT:

LE NOUVEAU MATÉRIEL NAVAL. 1890. Par A. Ledieu, correspondant de l'Institut de France, prix extraordinaire de l'Académie des sciences; officier de la Légion d'honneur et de l'instruction publique; commandeur, officier et chevalier de divers ordres étrangers; auteur de nombreuses publications sur les machines marines, la navigation, etc., et Ernest Cadiat, ingénieur des arts et manufactures. Price, Vol. I, 40 francs; Vol. II, 30 francs. Paris, Vve. Ch. Dunod, éditeur, Librairie des corps nationaux des ponts et chaussées des mines et des télégraphes, Quai des Augustins, 49. Vol. 1, 1889. L'ouvrage complet contiendra 260 figures intercalées dans le texte, et est accompagné d'un atlas de 50 planches. Tome premier: Balistique, agents explosifs, canons et mitrailleuses, hydraulique de manœuvre pour l'artillerie, fusils, électricité en marine, piles, accumulateurs, dynamos et magnétos, lumière et éclairage électriques, torpilles. 1890. L'ouvrage complet contient 300 figures intercalées dans le texte, et est accompagné d'un atlas de 51 planches et 6 grands tableaux. Tome second et dernier: Torpilles (suite et fin); torpilleurs et bateaux sous-marins; complément sur les armes à feu: appareils de sillage, de sondage et de signaux; utilisation industrielle du soleil et production mécanique de chaud et de froid; balons captifs et libres, aéronefs et avires, pigeons voyageurs; étude technique des guerres maritimes modernes et constitution des flotes actuelles; formes et utilisation des principaux types de navires présentement en usage.

LEGAL:

LA MARCHE ET LA CONDUITE DES CHRONOMÈTRES, APRÈS LES TRAVAUX DE MM. CASPARI LIEUSSOU, DE MAGNÆ, ETC. 1882. Par Fulgence Legal, lieutenant de vaisseau. Price, 1 franc 50 centimes. Paris: Berger-Levrault et C^{ie}, 5 rue des Beaux-Arts.

MACKROW:

THE NAVAL ARCHITECT'S, SHIPBUILDER'S, AND MARINE ENGINEER'S POCKET BOOK. 1892.

MARTIN:

A TREATISE ON NAVIGATION AND NAUTICAL ASTRONOMY. 1888. Compiled by Staff Commander W. R. Martin, R. N., instructor in nautical surveying, navigation, and compass adjustment, lecturer on meteorology at the Royal Naval College, Greenwich, and formerly Naval Assistant to the Hydrographer. London: Longmans, Green & Co., and New York: 15 East Sixteenth street. Sanctioned for use in the Royal Navy by the Lords Commissioners of the Admiralty.

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LES ARMES DE PETIT CALIBRE, ÉTUDE COMPARATIVE, and LES ARMES DE PETIT CALIBRE. Fusils en essai et en construction. Par Capt. J. de Monbrison. 1894. Paris: L. Baudoin, 30 rue Dauphine.

OFFICIER SUPÉRIEUR:

LES ARMES À FEU PORTATIVES DES ARMÉES ACTUELLES ET LEURS MUNITIONS. 1894. Par un officier supérieur. 131 illustrations. Paris: L. Baudoin, 30 rue Dauphine.

PAQUIÉ:

DE LA RASANCE DES FUSILS DE PETIT CALIBRE ET DE SES CONSÉQUENCES TACTIQUES. 1892. Par E. Paquié, colonel du 11^{e} régiment d'infanterie. Paris: L. Baudoin, 30 rue Dauphine.

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FLEET MANŒUVRING. By Pellews. Price, 12s. 6d. Portsmouth, England: Griffin & Co., No. 2 The Hard.

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POLLARD ET DUDEBOUT:

ARCHITECTURE NAVALE. Théorie du navire. 1890–1891. By J. Pollard et A. Dudebout, ingénieurs de la marine, professeurs à l'École du génie maritime. Paris, Gauthier-Villars et fils, imprimeurs-librairies du bureau des longitudes de l'École polytechnique, Quai des Grands-Augustins, 55. This is the most complete work on the subject of naval architecture that has ever been written, and probably the most authentic. Four volumes (sold separately).

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THE BOAT SAILER'S MANUAL. 1886. By Lieut. E. F. Qualtrough, United States Navy. New York: Charles Scribner's Sons.

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TREATISE ON AMMUNITION. Printed by order of the Secretary of State for War. Price, 6s. To be purchased, either directly or through any bookseller, from Eyre & Spottiswoode, East Harding street, Fleet street, E. C., London; or Adam & Charles Black, North Bridge, Edinburgh; or Hodges, Figgis & Co., 104 Grafton street, Dublin. Fifth edition, corrected to March 31, 1892.

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INDEX.

A.

Page.

- *Abdul Kader*, armored cruiser, Turkey 62
- *Achber*, gunboat, Turkey 63
- *Adamastor*, cruiser, Portugal 53
- *Admiral Senyavin*, C. D. V., Russia 54, 58
- *Admiral Ushakov*, C. D. V., Russia 54
- Advantages of electrical appliances on board ship 103
- *Aegir*, C. D. V., Germany 30, 31
- *Agostino Barbarigo*, gun vessel, Italy 48
- *Akashi*, protected cruiser, Japan 50
- *Alert*, gun vessel, Great Britain 41, 42
- *Algerine*, gun vessel, Great Britain 36, 41, 43
- Aluminum torpedo boat, France 28
- Ammunition:
  - Fixed 81
  - Stowage and care 70
  - Supply 71, 82
- *Ancona*, battle ship, Italy 48
- *Andromeda*, protected cruiser, Great Britain 35
- *Ardent*, torpedo boat, Great Britain 44
- Argentina:
  - Notes on ships and torpedo boats 9
  - small arms 96
- Armor:
  - Adoption of Harvey process 89
  - Firing trials 84, 86, 89
    - France 84
    - Germany 86
    - Great Britain 89
    - Netherlands 89
  - Notes 83
- Army:
  - Chinese, Japan-China war 218
  - Japanese, Japan-China war 218
- *Arrogant*, protected cruiser, Great Britain 35
- Asan, engagement 219
- *Assistance*, troop ship, Great Britain 43
- *Aurora*, cruiser, Austria 11
- *Australien*, steamship, experience with Belleville boilers 147
- Austria:
  - Notes on ships and torpedo boats 11
  - small arms 96
- Automatic machine gun 76
  - breech mechanism 76

B.

- *Baden*, battle ship, Germany 29, 33
- *Baiern*, battle ship, Germany 29, 33

Page

- Ballistics:
  - Formulas 81
  - Small arms 93
- *Banshee*, torpedo boat, Great Britain 44
- *Barfleur*, battery power 72
- *Batiuska*, dispatch vessel, Russia 53
- Battery power 72
- Belgium, notes on small arms 96
- Belleville boiler 142
  - boilers in French navy 154
- *Beowulf*, C. D. V., Germany 30
- *Berk-efschan*, torpedo boat, Turkey 63
- *Blake*, battery power 72
- Boilers:
  - Belleville 142
  - D'Allest 144
  - Lagrafel-D'Allest 143
  - Niclausse 144
  - Normand 137
  - Scotch 143
  - Tubulous, in French navy 141
- Books:
  - List of standard, on professional subjects 235
  - Foreign service and other periodicals 251
  - General works 235
  - Law and diplomacy 250
  - Natural sciences 249
  - Naval and military arts 236
  - Useful arts 242
- *Bouvines:*
  - Battle ship, France 24
  - Official trials of her D'Allest boilers 168
- *Boxer*, torpedo boat, Great Britain 44
- *Brandenburg*, battle ship, Germany 31
- *Brave*, river gunboat, France 23
- Brazil:
  - Notes on ships 14
  - small arms 97
- Breech closures:
  - Automatic 76
  - Bofors 80
  - Darmancier 76
  - French guns 68
  - Nordenfelt 73
- *Brennus:*
  - Battle ship, France 24
  - Trials of Belleville boilers 155

Page.
British naval ordnance 78
Brooklyn, battery power 72
Bruiser, torpedo boat, Great Britain 44
Bruix, armored cruiser, France 21
Buda-Pest, C. D. V., Austria 11, 12
Buenos Aires, P. C., Argentina 10
Buffel, C. D. V., Netherlands 51
Bugeaud, fitted with Belleville boilers, comparison with D'Allest and Niclausse boilers 172
Bulgaria, remarks on navy 15
Bullets, protection against 93

C.

Cæsar, battle ship, Great Britain 36
Calabria, protected cruiser, Italy 46
Canet guns, development 69
Capello, gunboat, Portugal 53
Capitan Prat, battery power 72
Caponnière mount 74
Cariddi, cruiser, Italy 48
Carnot:
  Battle ship, France 20
  Dimensions of D'Allest boilers of the 155
  Mounting of the D'Allest boilers of the 156
Cassini, torpedo vessel, France 26
Castelfidardo, old battle ship, Italy 48
Cecille, protected cruiser, France 27
Chacal, gun vessel, France 29
Champlain, cruiser, France 29
Chao yung, partially protected cruiser, China 16
Charger, torpedo boat, Great Britain 44
Charlemagne, battle ship, France 18
Chasseloup-Laubat, protected cruiser, France 25
  Fitted with D'Allest boilers 172
Châtillon-Commentry armor trials 85
Chen chung, gun vessel, China 16, 49
Chen nan, gun vessel, China 16, 49
Chen pei, gun vessel, China 16, 49
Chen pien, gun vessel, China 16, 49
Chen si, gun vessel, China 16, 49
Chen tung, gun vessel, China 16, 49
Chen yuen, battle ship, China 16, 49
Chih yuen, protected cruiser, China 16
Chile:
  Notes on ships 15
    small arms 97
China:
  Naval ordnance 66
  Notes on ships and torpedo boats 15
    small arms 97
Chin chu, gun vessel, Japan 49
Chin hoku, gun vessel, Japan 49
Chin nan, gun vessel, Japan 49
Chin pen, gun vessel, Japan 49
Chin sei, gun vessel, Japan 49
Chin to, gun vessel, Japan 49
Chin yen, battle ship, Japan 49
Ching yuen, protected cruiser, China 16
Citta di Genova, transport, Italy 48
Citta di Napoli, transport, Italy 48
Colonna, gun vessel, Italy 48
Comparative tests of new and old style D'Allest boilers 158

Page.
Concentration of gun fire by electricity 110
Conflict, torpedo boat, Great Britain 44
Contest, torpedo boat, Great Britain 44
Copper tubes in water-tube boilers 132
Cordite, amount manufactured 78
Cost of running Belleville boilers 154
Creusot armor trials 84
Croiseurs corsaires, France 19
Czar, river gunboat, Russia 59
Czariza, gunboat, Russia 59

D.

D'Allest boilers:
  Care when not in use 167
  Changing a tube 166
  Cleaning inside of the boiler 164
  Cleaning tubes 164
  Description 158
  General instructions for 167
  Leaks at plugs in boiler front 167
  Method of making trials of 159
  Official trials in the *Bouvines* 168
  Plugging a tube 166
  Preservation of the tubes 165
  Salt-water leaks in condenser 163
  Specialties in the design of 167
  Trials of, in the *Jemmapes* 168
  Use of the blows 163
Dandolo, battle ship, Italy 46
Daring, torpedo boat, Great Britain 44
Darmancier, R. F. G 76
Dasher, topedo boat, Great Britain 44
Decoy, torpedo boat, Great Britain 44
Delfino, submarine boat, Italy 48
Denmark, notes on ships and torpedo boats 16
Depression position finder 124
Derzava, imperial yacht, Russia 59
Descartes, protected cruiser, France 22
Deutschland, battle ship, Germany 29
De Vignaux, development of Canet guns 69
Diadem, protected cruiser, Great Britain 35
Diana, protected cruiser, Great Britain 36
D'Iberville, torpedo vessel, France 26
Dido, protected cruiser, Great Britain 36
Diego Cao, gunboat, Portugal 53
Doris, protected cruiser, Great Britain 36
Drac, transport, France 29
Dragon, torpedo boat, Great Britain 44
Dryad, torpedo vessel, Great Britain 42
Duilio, battle ship, Italy 46
Duport field gun 73
Dupuy de Lôme, armored cruiser, France 24
    battery power 72
Duquesne, cruiser, France 27
Du Temple boiler 131
Du Temple-Normand boiler 133

E.

Eclatante, river gunboat, France 23
Eclipse, protected cruiser, Great Britain 40
Ecuador, notes on ships 17
Electric lighting 104
Electric motors 105
Electric motors for training turrets 105
Electric sight 121

Page.

Electric ventilators ... 105
Electrical appliances on board, advantages of ... 103
Electrical firing of guns ... 109
Electrically operated steam whistles ... 104
Elswick:
    Automatic breech mechanism ... 79
    Eight-inch R. F. G ... 79
    Mount for heavy guns ... 80
Emperador Carlos V., armored cruiser, Spain ... 60
Ernest Simon, steamship, designed for Scotch boilers ... 147
Esmeralda. *See* Idzumi.
Espiègle, river gunboat, France ... 23
Euphrates, troop ship, Great Britain ... 43
Europa, protected cruiser, Great Britain ... 35
Européen, transport, France ... 29
Euryalus, cruiser, Great Britain ... 43
Evertsen, C. D. V., Netherlands ... 50
        armor trials ... 90

F.

Feed, Belleville boilers ... 150
Feed pumps, Belleville boiler ... 152
Feed regulators, Belleville boiler ... 151
Feed water, use of lime in, circular of French minister of marine on ... 172
Feiz-i-bahri, cruiser, Turkey ... 62
Ferret, torpedo boat, Great Britain ... 44
Fervent, torpedo boat, Great Britain ... 44
Field artillery, France ... 72
Field tubes in Collet-Niclausse boilers ... 134
Filling with water the Belleville boiler ... 148
Firing guns electrically ... 109
Fleet:
    Chinese, Japan-China war ... 217
    Japanese, Japan-China war ... 216
Fleurus, torpedo vessel, France ... 26
Flibustier, torpedo boat, France ... 28
Flora, protected cruiser, Great Britain ... 41
Formosa, Japanese operations in ... 232
Forte, protected cruiser, Great Britain ... 41
Fox, protected cruiser, Great Britain ... 41
Foxhound, gunboat, Great Britain ... 43
France:
    Appropriation for armaments ... 67
    Armor ... 84
    Guns ... 68
    Guns with *viroles* ... 69
    Naval manœuvres ... 200
    Notes on ships and torpedo boats ... 17
        small arms ... 97
Freya (Ersatz), protected cruiser, Germany ... 30
Friant, protected cruiser, France ... 25
    fitted with Niclausse boilers ... 145-172
Friedrich der Grosse, battle ship, Germany ... 29
Friesland, protected cruiser, Netherlands ... 51
Frithiof, C. D. V., Germany ... 30
Furious, protected cruiser, Great Britain ... 35

G.

Galissonière, A. C., France ... 29
Gaulois, battleship, France ... 18

Page.

Gavre armor trials ... 84
Gefion, protected cruiser, Germany ... 32
Geier, cruiser, Germany ... 31
General Admiral Apraxine, C. D. V., Russia ... 54, 55
General Alava, transport, Spain ... 61
Germany:
    Appropriation for armaments; armor ... 77
    Notes on ships and torpedo boats ... 29
Giuseppe Garibaldi, A. C., Argentina ... 9
Gladiator, protected cruiser, Great Britain ... 35
Goito, torpedo vessel, Italy ... 48
Gondul, torpedo boat, Sweden ... 62
Goubet, submarine boat, France ... 29
Grand Duke No. 1, transport, Russia ... 54
Grand Duke No. 2, transport, Russia ... 56
Great Britain:
    Appropriation for armaments ... 77
    Armor ... 89
    Guns ... 78
    Naval manœuvres ... 177
    Notes on ships and torpedo boats ... 34
        small arms ... 97
Gudur, torpedo boat, Sweden ... 62
Guinea, C. D. V., Netherlands ... 51
Gun mounts:
    Bofors ... 81
    Canet ... 69
    Caponnière ... 74
    Elswick improved ... 79
    Japan ... 66
    R. F. G ... 75
Guns:
    Bofors ... 80
    Canet ... 69
    Darmancier ... 76
    Duport ... 73
    Field ... 72
    Hontoria ... 80
    Hotchkiss automatic ... 76
    Krupp ... 66
    Nordenfelt ... 73
    Woolwich wire-wound ... 79
Guns, R. F.:
    Bofors ... 80
    Canet ... 69
    Darmancier ... 76
    Hontoria ... 80
    Hotchkiss ... 76
    Navy—
        France ... 68
        Japan ... 65
Gustave Zédé, submarine boat, France ... 28

H.

Hagen, C. D. V., Germany ... 30, 32
Halcyon, torpedo vessel, Great Britain ... 42
Hannibal, battle ship, Great Britain ... 36
Hardy, torpedo boat, Great Britain ... 44
Harrier, torpedo vessel, Great Britain ... 42
Hasty, torpedo boat, Great Britain ... 44
Haughty, torpedo boat, Great Britain ... 44
Havock, torpedo boat, Great Britain ... 44
Hazard, torpedo vessel, Great Britain ... 42
Heimdal, protected cruiser, Denmark ... 17

Page.
Heimdall, C. D. V., Germany... 30, 32
Hei yen, C. D. V., Japan... 49
Hela, dispatch vessel, Germany... 31
Henri IV, battle ship, France... 18
Hildebrand, C. D. V., Germany... 30, 32
Hoche, battle ship, France... 24
Holland, protected cruiser, Netherlands... 51
Horizontal base position finder... 127
Hornet, torpedo boat, Great Britain... 44
Hotchkiss machine gun... 76
Hotchkiss R. F. G., explosion of... 67
Hudavendikiar, protected cruiser. Turkey... 62
Hussar, torpedo vessel, Great Britain... 42
Hydraulic motors for training turrets... 105

I.

Idzumi (ex-*Esmeralda*), protected cruiser, Japan... 49
Illustrious, battle ship, Great Britain... 36
Impetueuse, river gunboat, France... 23
Independencia, gunboat, Santo Domingo... 59
Infernale, river gunboat, France... 23
Influence of active circulation on transmission of heat... 135
Insolant, river gunboat, France... 23
Invincible, river gunboat, France... 23
Isis, protected cruiser, Great Britain... 36
Italia, battle ship, Italy... 46
Italy:
  Notes on ships and torpedo boats... 45
    small arms... 97
Ivens, gunboat, Portugal... 53

J.

Janus, torpedo boat, Great Britain... 44
Japan-China war, notes on... 215
Japan:
  Notes on guns and mounts... 65
    ships and torpedo boats... 48
Jeanne d'Arc, armored cruiser, France... 18
Jemmapes, battle ship, France... 24
Jemmapes, trial of D'Allest boilers... 155, 168
Juno. protected cruiser, Great Britain... 36
Jupiter, battle ship, Great Britain... 36

K.

Kaiser, battle ship, Germany... 33
Kaiserin und Königin Maria Theresia, protected cruiser, Austria... 11, 13
Kersaint, dispatch vessel, France... 20
Khabarovsk, transport, Russia... 54, 56
Kherson, transport, Russia... 54, 56
Khrabry, armored gun vessel, Russia... 54, 55
Kilid Bahr, gun vessel, Turkey... 63
King yuen, C. D. V., China... 16
König Wilhelm, battle ship, Germany... 29
Kohei, cruiser, Japan... 49
Kortenaer, C. D. V., Netherlands... 50
    armor trials... 89, 91
Kowshing affair, Japan-China war... 219
Krag-Jorgensen rifle, Norway... 98
Krupp nickel steel armor trials... 86
  Gun in Chinese navy... 66
Kuang kia, partially protected cruiser, China... 16
Kuang ping, partially protected cruiser, China... 16, 49
Kuang yi, partially protected cruiser, China... 16
Kurfürst Friedrich Wilhelm, battle ship, Germany... 31

L.

Lacerda, gunboat, Portugal... 53
Lagrafel-D'Allest boiler... 143
Lai yuen, C. D. V., China... 16
Lansquenet, torpedo boat, France... 28
Latouche-Tréville, armored cruiser, France... 25
Lee-Metford bullet, penetration... 93
Lee-Metford rifle, Great Britain... 97
Leipzig, cruiser, Germany... 29
Leitha, river monitor, Austria... 11
Lepanto, battle ship, Italy... 46
Liban, steamship, care of D'Allest boilers... 161
Liberia, notes on ships... 50
Lightning, torpedo boat, Great Britain... 44
Linois, protected cruiser, France... 26
Locust, tug, Great Britain... 43
Lussin, torpedo vessel... 11
Lynx, torpedo boat, Great Britain... 44

M.

Magenta, battle ship, France... 24
Magnificent, battle ship, Great Britain... 36
Majestic, battle ship, Great Britain... 36
Manchuria, invasion of... 227, 231
    Spring campaign in... 231
Mannlicher automatic breech mechanism... 95
Mannlicher bullet, penetration... 93
Mannlicher rifle:
    Austria... 96
    Netherlands... 98
    Roumania... 98
Marco Polo, armored cruiser, Italy... 46
Marengo, battle ship, France... 29
Maria Adelaide, old battle ship, Italy... 48
Maros, river monitor, Austria... 11
Marrel Frères, armor trials... 85
Mars, battle ship, Great Britain... 36
Mauser rifle:
    Argentina... 96
    Belgium... 96
    Brazil... 97
    Chile... 97
    Mexico... 97
    Spain... 101
    Sweden... 101
    Turkey... 101
Mei yuen, gun vessel, China... 16, 49
Messageries Maritimes, use of Belleville boilers... 147
Mexico, notes on small arms... 97
Monarch, C. D. V., Austria... 11, 12
    old battle ship, Great Britain... 43
Moskwa, river gunboat, Russia... 59
Motors, electric... 105
Mouzin rifle, Russia, description... 98

N.

Page.

- **Naval** manœuvres, 1894:
  - **France—**
    - Atlantic and Channel 201
    - Channel—
      - Attack on Havre and coast 203
      - Casualties 208
      - Fleet formation, Douarnenez Bay 207
      - Forcing the Straits of Dover 204
      - Torpedo boat attack off Brest 208
      - Torpedo boat attack, Douarnenez Bay 207
    - Coast-defense system 200
    - Comments 213
    - Mediterranean—
      - Casualties 212
      - Combined operations 211
      - Fleet, composition 209
      - General scheme 209
      - Vessels mobilized 210
    - Northern squadron, composition 202
    - *Réservistes* and vessels mobilized 202
  - Great Britain—
    - A fleet, composition 181
    - A fleet, movements 189
    - B fleet, composition 182
    - B fleet, movements 189
    - Blue side, composition 183
    - Blue side, plan 190
    - C fleet, composition 183
    - C fleet, movements 190
    - Casualties 196
    - Coaling 195
    - Comments 198
    - D fleet, composition 184
    - D fleet, movements 191
    - Formations and evolutions 192
    - Mobilization 177
    - Orders and instructions, general 179
    - Preliminary exercises 186
    - Red side, composition 181
    - Red side, plan 189
    - Signals 195
    - Target practice 196
    - Torpedo boat flotilla 185
    - Torpedo boats 194
- *Navarin*, battle ship, Russia 54
- Netherlands:
  - Armor trials 89
  - Notes on ships and torpedo boats 50
    - small arms 98
- *Nettle*, hulk, Great Britain 43
- Niclausse boiler 144, 168
- Niclausse boilers, care of 170
- *Nimet*, torpedo vessel, Turkey 62
- *Niobe*, protected cruiser, Great Britain 35
- Nobel powder 81
- Nordenfelt, R. F. G 73
- Normand boiler, arrangement of cluster of tubes 137
- Norway:
  - Notes on ships and torpedo boats 52
    - small arms 98
- Notes:
  - Armor 83

Page.

- Notes—Continued.
  - Japan-China war 215
  - Ordnance 65
  - Ships and torpedo boats 9
  - Small arms 93
- *Nueve de Julio*, battery power 72

O.

- *Ocean*, battle ship, France 29
- *Oden*, C. D. V., Sweden 62
- *Odin*, C. D. V., Germany 30, 31
- *Oldenburg*, battle ship, Germany 33
- *Opossum*, torpedo boat, Great Britain 44
- *Otvajnii*, armored gun vessel, Russia 56, 58

P.

- *Palestro*, old battle ship, Italy 48
- *Patria*, torpedo vessel, Argentina 10
- *Pedro Annaya*, gunboat, Portugal 53
- *Peleng-i-Derya*, torpedo vessel, Turkey 62
- *Pelorus*, cruiser, Great Britain 36
- Penetration, small-caliber bullet 93
- Pescadores, Japanese operations in 232
- *Petersburg*, river gunboat, Russia 59
- *Petropavlovsk*, battle ship, Russia 54, 57
- *Phœnix*, gun vessel, Great Britain 36, 41
- *Piet Hein*, C. D. V., Netherlands 50, 51
- *Piet Hein*, armor trials 89
- *Piemonte*, battery power 72
- Pingyang, capture of, Japan-China war 220
- *Ping yuen*, C. D. V., China 16, 49
- *Poltava*, battle ship, Russia 54, 57
- *Porcupine*, torpedo boat, Great Britain 44
- Port Arthur campaign 224
- Portugal, notes on ships and torpedo boats 52
- Position finders 122
- Poung Do, engagement 218
- *Poursuivante*, river gunboat, France 23
- *Powerful*, armored cruiser, Great Britain 36, 39
- *Précieuse*, river gunboat, France 23
- *Presidente Pinto*, battery power 72
- *Preussen* (Ersatz), battle ship, Germany 29
- *Prince George*, battle ship, Great Britain 36
- *Principe Amadeo*, old battle ship, Italy 48
- Progress in the naval use of electricity 103
- *Proserpine*, cruiser, Great Britain 36
- Protection against small-caliber bullet 93
- *Protet*, protected cruiser, France 19

Q.

- *Quiros*, gun vessel, Spain 61

R.

- *Raket*, torpedo boat, Norway 52
- Raising steam, Belleville boiler 148
- Range finder 111
- Range indicating system 118
- *Ranger*, torpedo boat, Great Britain 44
- Rapid-fire guns and mounts:
  - Japan 65
  - France 68
  - Spain 80
  - Sweden 80
- Rate of fire 72, 81
- *Rechber*, gunboat, Turkey 63

Page.
- *Redoutable*, battle ship, France 27
- *Reina Regente*, protected cruiser, Spain 61
- *Renown*, battle ship, Great Britain 38
- *Riachuelo*, battle ship, Brazil 14
- Ricochet, small-caliber bullets, experiments 94
- *Rocket*, torpedo boat, Great Britain 44
- *Rocktown*, gunboat, Liberia 50
- *Roma*, old battle ship, Italy 48
- *Rossilnii*, dispatch vessel, Russia 59
- *Rostislar*, battle ship, Russia 54
- Roumania, notes on small arms 98
- *Rover*, cruiser, Great Britain 43
- Running the boilers of the *Australien* 148
- *Rurik*, armored cruiser, Russia 54, 58
- *Rurik No. 3*, armored cruiser, Russia 54, 55
- *Rusée*, river gunboat, France 23
- *Russia*, armored cruiser, Russia 54
- Russia:
  - Notes on ships and torpedo boats 53
    - small arms 98

S.

- *Saati*, store ship, Italy 48
- *Sachsen*, battle ship, Germany 29, 33
- *Saida*, cruiser, Austria 11
- *Saiyen*, C. D. V., Japan 49
- *Salmon*, torpedo boat, Great Britain 44
- *Samoied*, transport, Russia 54, 56
- *San Martino*, old battle ship, Italy 48
- *Saone*, transport, France 29
- *Sardegna*, battle ship, Italy 46
- *Schadié*, cruiser, Turkey 62
- Schmidt rifle, Switzerland 101
- Schneider cementation process 85
- Scotch boilers 143
- *Sebenico*, torpedo vessel, Austria 11
- *Sedul Bahr*, gun vessel, Turkey 63
- *Selimie*, protected cruiser, Turkey 62
- *Serapis*, troop ship, Great Britain 43
- *Serpa Pinto*, gunboat, Portugal 53
- *Sevastopol*, battle ship, Russia 54, 57
- *Seyad-i-Derya*, gunboat, Turkey 63
- *Shark*, torpedo boat, Great Britain 44
- *Shefket Numa*, gunboat, Turkey 63
- Ships and torpedo boats:
  - Argentina 9
  - Austria 11
  - Brazil 14
  - Bulgaria 15
  - Chile 15
  - China 15
  - Denmark 16
  - Ecuador 17
  - France 17
  - Germany 29
  - Great Britain 34
  - Italy 45
  - Japan 48
  - Liberia 50
  - Netherlands 50
  - Norway 52
  - Portugal 52
  - Russia 53
  - Santo Domingo 59
- Ships and torpedo boats—Continued.
  - Spain
  - Sweden
  - Turkey
- *Siegfried*, C. D. V., Germany
- Sights, method of fitting
- *Sisoi Velikii*, battle ship, Russia
- *Sisoi Velikii No. 3*, battle ship, Russia
- *Skate*, torpedo boat, Great Britain
- Small arms:
  - Argentina
  - Austria
  - Belgium
  - Brazil
  - Chile
  - China
  - France
  - General remarks
  - Great Britain
  - Italy
  - Mannlicher automatic system
  - Mexico
  - Mouzin rifle
  - Netherlands
  - Norway
  - Penetration experiments
  - Roumania
  - Russia
  - Spain
  - Sweden
  - Switzerland
  - Turkey
- Smokeless powder
- *Snapper*, torpedo boat, Great Britain
- *Soko*, gun vessel, Japan
- *Sokol*, torpedo boat, Russia
- Spain, Hontoria R. F. G.
- Spain:
  - Notes on ships and torpedo boats
    - small arms 1
- Speaking tubes compared with telephones 1
- *Spitfire*, torpedo boat, Great Britain
- Stadimeter 1
- *Standard*, imperial yacht, Russia 54,
- *Starfish*, torpedo boat, Great Britain
- St. Chámond, armor trials
- Steam whistles, electrically operated 1
- Steel tubes in water-tube boilers 1
- Strains due to expansion of heating tubes 1
- *Sturgeon*, torpedo boat, Great Britain
- Submarine boats
- *Sultan*, old battle ship, Great Britain
- *Suma*, protected cruiser, Japan
- *Sunfish*, torpedo boat, Great Britain
- *Surly*, torpedo boat, Great Britain
- *Surprise*, gun vessel, France
- *Svea*, C. D. V., Sweden
- Sweden:
  - Naval ordnance
  - Notes on ships and torpedo boats
    - small arms 10
- Sweeping tubes by steam, Belleville boiler 15
- Switzerland, notes on small arms 10
- *Swordfish*, torpedo boat, Great Britain 4

T.

Page.

- *Taijar*, torpedo boat, Turkey 63
- *Talbot*, protected cruiser, Great Britain 40
- *Tamar*, troop ship, Great Britain 43
- *Teazer*, torpedo boat, Great Britain 44
- Telephones 110
- Telescope sight 119
- *Terrible*, armored cruiser, Great Britain 36, 39
- Thornycroft boilers 139
- *Tingyuen*, battle ship, China 16
- *Torch*, gun vessel, Great Britain 41
- Torpedo boats:
  - Argentina 11
  - Austria 11, 14
  - China 16
  - Denmark 16
  - France 17, 27
  - Germany 33
  - Great Britain 34, 43
  - Italy 48
  - Japan 50
  - Norway 52
  - Portugal 52
  - Russia 59
  - Sweden 62
  - Turkey 63
- *Tourville*, cruiser, France 27
- Transmitters of orders 119
- Treaty of peace, Japan-China war 233
- Trials:
  - Armor 84
  - Gun 69
  - Results of, with D'Allest boilers 160
- *Tri Sviatitelya*, battle ship, Russia 54
- *Trombe*, river gunboat, France 29
- *Tsao kiang*, dispatch vessel, China 16
- *Tsi yuen*, C. D. V., China 16, 49
- Tubulous boilers in the French navy 141
- Turkey:
  - Notes on ships and torpedo boats 62
  - small arms 101
- Turret motors, hydraulic and electric 105

U.

- Use of lime in feed water, circular of French minister of marine on 172

V.

- *Valmy*, battle ship, France 24
- *Varg*, torpedo boat, Norway 52
- *Veinte cinco de Mayo*, battery power 72
- *Venezia*, old battle ship, Italy 48
- Ventilators, electric 105
- *Venus*, protected cruiser, Great Britain 36
- *Verni*, school ship, Russia 54, 56
- Vickers Sons & Co., armor trials 84
- *Victorious*, battle ship, Great Britain 36
- *Vigilante*, river gunboat, France 23
- *Vindictive*, protected cruiser, Great Britain. 35
- *Vinte e quatro de Maio*, battle ship, Brazil .. 15
- *Viscaya*, armored cruiser, Spain 61
- Visual indicators for transmitting orders .. 111
- *Vladimir*, transport, Russia 54, 56

W.

- Waltham Abbey, cordite factory 78
- War, Japan-China, notes:
  - Asan 219
  - Close of war 233
  - Formosa 232
  - Manchuria 227, 231
  - Outbreak 215
  - Pescadores 232
  - Pingyang 220
  - Port Arthur 224
  - Poung Do 218
  - Weihaiwei 229
  - Yalu 221
- *Washington*, transport, Italy 48
- Water-tube boilers 131
- Weihaiwei campaign 229
- *Weissenburg*, battle ship, Germany 31
- *Wei yuen*, cruiser, China 16
- *Wien*, C. D. V., Austria 11, 12
- Wire-wound guns, manufacture 79
- *Wizard*, torpedo boat, Great Britain 44
- *Wörth*, battle ship, Germany 31
- *Württemberg*, battle ship, Germany 29, 33

Y.

- Yalu, battle of 221
- *Yung wei*, partially protected cruiser, China. 16

Z.

- *Zara*, torpedo vessel, Austria 11
- *Zebra*, torpedo boat, Great Britain 44
- *Zeeland*, protected cruiser, Netherlands 51
- *Zélée*, river gunboat, France 23
- *Zephyr*, torpedo boat, Great Britain 44
- *Zohaf*, gun vessel, Turkey 63
- *Zrinyi*, cruiser, Austria 11

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